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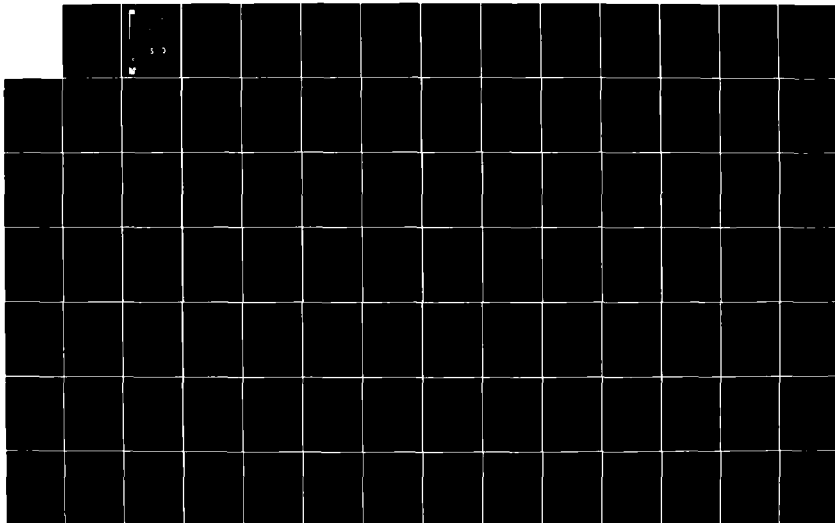
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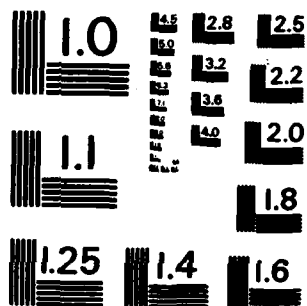
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NUCLEAR TESTING AND NATIONAL SECURITY

ROGER N. FRITZEL

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**NUCLEAR TESTING
AND
NATIONAL SECURITY**

by

**Lieutenant Colonel Roger N. Fritz, USAF
Senior Research Fellow
Research Directorate**

National Security Affairs Monograph Series 81-2

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CONTENTS

	Page
Foreword	v
About the Author	vi
Glossary of Treaties	vii
I. EXECUTIVE SUMMARY	1
II. HISTORICAL CONTEXT	5
III. NUCLEAR DISARMAMENT AND NUCLEAR DETERRENCE	9
Nuclear Disarmament Negotiations	10
Test-Ban Objectives	12
Test-Ban Implications	14
Nuclear Deterrence	16
Deterrence-Disarmament Policy Contradictions ...	17
Nuclear Testing and the Arms Control Process	22
IV. MONITORING NUCLEAR TEST ACTIVITY	27
Monitoring Arrangements	27
Monitoring Thresholds	29
On-Site Inspections	30
Data Exchange	31
Verification Policy	32
Banning Fusion Technology	34
Some Monitoring Problems	36

	Monitoring and Treaty Structure	40
	CTBT Verification Provisions	41
V.	NUCLEAR EXPLOSIVE TECHNOLOGY	47
	Maturity of Nuclear Explosive Technology	48
	Lost Technical Achievements	50
	Inertial Confinement Fusion Technology	52
	Training Nuclear Weapons Scientists	61
	Banning Technology Through Arms Agreements ...	64
VI.	NUCLEAR STOCKPILE CONFIDENCE	73
	Reliability: A Controversial Issue	73
	Key Arguments About Stockpile Confidence	74
	Test-Ban Treaty Duration	78
	Safeguards	79
	Experiences in Stockpile Confidence Testing	81
	Yields for Stockpile Confidence Tests	82
VII.	CTB AND NONPROLIFERATION	87
	Nuclear Proliferation Issues	87
	Changing Perspectives on Proliferation	90
	Inertial Fusion and Proliferation	91
	The Test-Ban-Proliferation Linkage	93
	<i>List of Abbreviations</i>	97
	<i>Selected Bibliography</i>	99

FOREWORD

This monograph is the first to include an Executive Summary, designed to assist our readers in their use of our monographs.

Since the 1950s, the United States has negotiated more than fifteen arms control agreements, several of which limited nuclear explosive testing by the signatories. Negotiations on another treaty on nuclear testing have been ongoing in Geneva since October 1977, between the United States, the Soviet Union, and the United Kingdom. This treaty would go beyond previous agreements limiting nuclear testing and impose a total ban on all nuclear explosive testing. Proponents of this Comprehensive Test Ban Treaty suggest that it will inhibit the further spread of nuclear weapons technology, lessen the superpower arms race, and be a stabilizing force in world affairs.

In this monograph, Lieutenant Colonel Fritzelt contends that US support of this agreement is inconsistent with the US doctrine of strategic nuclear deterrence. Without testing to modernize US nuclear weapons, the United States cannot have an effective nuclear deterrent force, which Colonel Fritzelt argues is a stabilizer in the international arena. Noting that past agreements intended to curb nuclear proliferation and the increase in nuclear arsenals have largely failed, the author questions the utility of this treaty in advancing either US national security objectives or global peace. He suggests that the contradictions in our nuclear testing policy and our doctrine of nuclear deterrence be resolved, and that the United States adopt a holistic approach to arms control and defense needs to insure that decisions in each sphere are considered for their implications on the others.

The issues raised by the Comprehensive Test Ban Treaty will remain important arms control concerns. We present the research and views developed by Colonel Fritzelt as one contribution to the ongoing dialogue which accompanies major national policy choices on important security issues.



JOHN S. PUSTAY
Lieutenant General, USAF
President

ABOUT THE AUTHOR

Lieutenant Colonel Roger N. Fritz, United States Air Force, researched and wrote this monograph while serving as a Senior Research Fellow in the Research Directorate, the National Defense University. He is presently assigned as Chief, Joint Exercise/Tactical Intelligence Branch, Directorate for Intelligence and External Affairs, Defense Intelligence Agency. Prior to his 1980 graduation from the Industrial College of the Armed Forces, Lieutenant Colonel Fritz was assigned to the Deputy for International Negotiations, Plans and Policy Directorate (J-5), Organization of the Joint Chiefs of Staff. That assignment included duty as JCS Representative on the US Delegation to the Conference of the Committee on Disarmament, and the US-USSR negotiations on radiological weapons. He has served in staff intelligence and international politico-military affairs positions with Headquarters, Strategic Air Command, Pacific Air Forces; and the Office of the Vice Chief of Staff of the Air Force. He received a Bachelor of Science degree from the United States Naval Academy, a Master of Aerospace Management from the University of Southern California, and is a graduate of the Armed Forces Staff College. Lieutenant Colonel Fritz also has had assignments with the 355th Tactical Fighter Wing in Southeast Asia, and the 544th Aerospace Reconnaissance Technical Wing (SAC).

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GLOSSARY OF TREATIES

Comprehensive Test Ban Treaty (CTBT)*: A treaty which would prohibit any nuclear test explosion, in any environment. The word "comprehensive" is defined as "including much, comprising many things, having a wide scope, inclusive." The phrase "comprehensive test ban" has come to mean, in the vernacular, "total, complete, or zero-yield," a test ban which would be all-inclusive. Negotiations for a CTBT carried out between 1977 and 1980 completed almost all the language for a treaty among the United States, the Union of Soviet Socialist Republics, and the United Kingdom.

Threshold Test Ban Treaty (TTBT)**: A treaty signed in Moscow on 3 July 1974, in which parties undertake to prohibit any underground nuclear weapon test having a yield exceeding 150 kilotons, to limit the number of their tests to a minimum, and to continue negotiating a CTBT. The United States has not ratified the TTBT.

Peaceful Nuclear Explosions Treaty (PNET)**: A treaty signed in Washington on 28 May 1976, in which parties undertake not to carry out any individual nuclear explosions with yield exceeding 150 kilotons, or any group explosions with an aggregate yield exceeding 1,500 kilotons, and to comply fully with the Limited Test Ban Treaty. The United States has not ratified the PNET, which is a companion to the TTBT.

Non-Proliferation Treaty (NPT)**: A treaty signed in Washington, London, and Moscow on 1 July 1968, and ratified by the United States on 5 March 1970. The NPT is designed to prevent the spread of nuclear weapons ("horizontal" proliferation), to provide assurance that the peaceful nuclear activities of states which have not already developed nuclear weapons will not be diverted to making such weapons, to promote the peaceful uses of nuclear energy, and to express the determination of parties that the treaty should lead to nuclear disarmament.

Limited Test Ban Treaty (LTBT)**: A treaty signed in Moscow on 5 August 1963, and ratified by the United States on 10 October 1963. Parties undertake to prohibit any nuclear weapon test explosion, or any other nuclear explosion, in the atmosphere, in outer space, and under water; or in any other environment (that is, underground) if

such explosion causes radioactive debris to be present outside the territory of the state that controls the explosion.

**See Department of State Bulletin, "Report on CTB Negotiations," vol. 80, no. 2044.*

***For further details, see Arms Control and Disarmament Agreements, Texts and Histories of Negotiations, ACDA Publication 105, August 1980.*

I. EXECUTIVE SUMMARY

The issue of a cessation of nuclear testing has been with us since the dawn of the nuclear age; and it will not go away soon, even if a decision were made to let the "Carter round" of comprehensive test-ban negotiations end with the Carter administration.

The political appeal of the idea of a total test ban has been fostered through years of disarmament dogma propounded in the United States and the United Nations. The dogma, briefly stated, is that in a test-ban "regime" both US and Soviet weapons and stockpiles will degrade equally (or "symmetrically"). But, because the United States is "superior" to the Soviet Union in nuclear weapons technology—an unprovable technical judgment that average citizens are flattered to believe—the test ban will allegedly leave us with an advantage. Energy Department officials, responsible by law for the nuclear weapons stockpile, have clearly and repeatedly testified before Congress that testing is indispensable for long-term maintenance of our nuclear weapons stockpile, regardless of whether the Soviets observe a ban or not. But, in the absence of public awareness of the extremely adverse military consequences of a total nuclear test ban, citizens and politicians cannot be expected to question the basic dogma.

Disarmament dogma thrives on the notion of a runaway nuclear arms race, including massive and needless test programs. But Congress reported in December 1979 that the Energy Department budget for funding the nuclear testing program was inadequate to support existing and planned weapons systems.

America's nuclear testing program is an important national security resource. First of all, the technology of nuclear explosives is a US Government monopoly. Unlike other critical basic industries undergirding our military posture (shipbuilding or electronics, for instance) there is no "second source" to design, develop, test, engineer for production, build, maintain, modify, and retire nuclear weapons. Recourse to underground tests at the Nevada Test Site is an indispensable asset to the weapons experts in the nuclear laboratories, who must routinely work with all the other major entities in the nuclear weapons production complex to have a practicable program.

Of the 40,000 people within the nuclear weapons complex of the Department of Energy, about 10,000 are highly skilled scientists, engineers, and technicians of the national laboratories who are part of a technological monopoly. If nuclear explosive technology is not maintained by the government, it will be lost to our country.

In addition to production of new weapons, maintenance of the stockpile, including modernization of older weapons such as the W68/Poseidon warhead and the B28 strategic bomb, has reached the level of a major responsibility for the weapons complex, and that need will not soon decline.

We have already greatly reduced our nuclear test activity in terms of numbers, yields, and diversity of test objectives. There should be no public perception of a "runaway" test program, with scientists quickly putting into bore holes their latest schemes. Our test program is carefully calibrated to take into account weapons development needs, the strictures of the Limited Test Ban Treaty (LTBT) and the Threshold Test Ban Treaty (TTBT), the possibility of a Comprehensive Test Ban (CTB) Treaty, UK requirements, Non-Proliferation Treaty (NPT) requirements, and all other pertinent arms control commitments. Each test is personally approved by the President.

In reviewing the background on the nuclear test ban question, one finds a pattern of growing constraints on our nuclear testing. Repeated national pledges to an eventual total test ban have provided a subliminal rationale for agreeing to numerous interim restrictions. Thus, nuclear budget cuts met little resistance during the 1970s. Can we continue to reduce our testing efforts with unilateral and negotiated restraints? Is there an irreducible minimum level of US nuclear test activity?

Linkage between the test ban and our nuclear force programs does exist. It is that all bans or limitations on testing are designed to undercut nuclear weapons capability in some way and to some degree. Many military professionals and other national security decisionmakers take nuclear bombs and warheads for granted—as "givens" in their force planning and projections. But growing antinuclear sentiment is linking opposition to nuclear power plants with opposition to nuclear weapons. Because many are adamantly opposed to any US employment of nuclear weapons, all the force programs involving nuclear systems, and the overall strategy, are constantly being "reviewed."

Despite many objections, nuclear deterrence remains the basic military doctrine for defense of the United States. This is the doctrine responsible policy officials must address. Massive investments to procure and operate strategic, theater, and tactical nuclear deterrent forces—over \$30 billion for MX alone—are becoming less credible because of the countervailing doctrine of nuclear disarmament, which hinges on a cessation of nuclear testing. If the United States really plans to maintain its nuclear deterrent force through the 1980s and beyond, logic would dictate that we also take all steps necessary to keep it secure and reliable. Therefore, an indefinite postponement of the comprehensive test ban should be the policy.

Beyond the undebated policy issue of our relative commitment to nuclear deterrence or nuclear disarmament, four other fundamental test-ban issues demand careful study.

Monitoring nuclear test activity. Deprivation of all US testing will progressively rob our country of the expertise needed to assess the progress other nations have achieved by testing at yields below the monitoring threshold. Seismic monitoring—including the national seismic stations (NSS)—along with “other technical means,” will never be sufficiently capable to assure this country of others’ compliance with a zero-yield test ban.

Nuclear explosive technology. The means to design and certify new nuclear weapons, and “fixes” to existing ones, cannot be kept alive without some testing—it is that simple. The development of capabilities for setting off nuclear-fusion explosions using the inertial confinement technique challenges the whole concept of prohibiting states from realizing the military benefits of nuclear explosions by imposing a ban policed primarily by seismic monitoring techniques. A comprehensive test ban would foreclose very important new technological developments, especially the needed application of insensitive high explosive (IHE) technology to our stockpiled weapons.

Nuclear stockpile confidence. The question of nuclear stockpile confidence, even in a CTB regime of “fixed duration,” is perhaps the most pressing issue from the military point of view. No new designs can be certified without testing, and the same logic applies to fixes of problems in stockpile weapons. Without testing, the stockpile will degrade and become unreliable. This fact remains, despite the effort to finesse the issue through a policy decision to seek a 3-year “fixed duration” ban. The absence of an ongoing test program will in-

evitably undercut our design and maintenance capability to some degree. A 3-year test ban would immediately deprive the United States of a data base on technologies and components being employed in new-generation weapons going into production for the stockpile of the 1980s and 1990s. America has no "options" if our nuclear technology infrastructure becomes undermined by a test ban. The technology and advanced developments to meet future requirements, and the expertise to maintain our existing nuclear stockpile, must be provided for by the actions of the US Government—there is no "second source."

Testing and nuclear proliferation. A decade into the Non-Proliferation Treaty regime, the comprehensive test ban concept is failing the test of relevance to the most pressing issues of nuclear proliferation. A test ban could actually increase danger by masking proliferation of conservatively designed—but untested—weapons. The role of a comprehensive test ban in advancing US nuclear non-proliferation objectives is by far the most emphasized benefit of a test-ban treaty. Yet, analysts on both sides of the CTB issue now recognize that CTB is only one piece of a very complicated horizontal non-proliferation puzzle. And the short-duration test ban now emerging—especially if it entails guaranteed resumption of full-scale testing by the United States—can scarcely be considered credible by the "overhanging" proliferator states.

Having examined all the fundamental issues, it is difficult to then accept the proposition that US participation in a comprehensive test ban will strengthen global stability and promote our security interests, even though we have promised for years to begin nuclear disarmament in the particular way represented by a CTB.

More rational is the proposition that American security would be strengthened if our country put the world on notice that we are determined to respond to the compelling demands to meet the many grave security challenges we face, on behalf of other free peoples, with all the resources of defense at our command. We would be better served by frankly admitting to ourselves, our friends, and our adversaries that our security needs are inconsistent with the timeworn concept of a comprehensive test ban, than by continuing with a pretense that cannot, and should not, be sustained.

II. HISTORICAL CONTEXT

Testing of nuclear explosive devices has always been the bedrock upon which rests the technology of nuclear weapons, and hence the credibility of US nuclear deterrence. Therefore, the policy of our government toward nuclear testing is of paramount military significance.

Present US policy permits a limited number of tests each year by the Los Alamos and Livermore National Laboratories.¹ The Senate has held in abeyance ratification of two treaties, negotiated with and signed by the Soviet Union, in the interest of seeking the so-called comprehensive test ban, or "CTB."

"Comprehensive test ban" is an American phrase, seldom used by other nations, and is potentially misleading. The title of the treaty now being negotiated with the Soviets and British says nothing about a "comprehensive" ban, and former Secretary of Defense Harold Brown told Congress that what we are negotiating will not be truly "comprehensive," in that a compliance-monitoring threshold will always exist.

The test-ban negotiations proceed from an assumption that it would be desirable for the United States to cease nuclear testing. This assumption reflects traditional US nuclear arms control and disarmament² doctrine from the Geneva Conference on the Discontinuance of Nuclear Weapon Tests in the 1950s, through the Limited Test Ban Treaty, the Non-Proliferation Treaty, the Threshold Test Ban Treaty, and the Peaceful Nuclear Explosions Treaty.

In 1977, the Carter administration quickly established numerous sets of arms control and disarmament negotiations with the Soviet Union.

In May 1978, Melvin Price, Chairman of the House Armed Services Committee (HASC) appointed a subcommittee panel on the Strategic Arms Limitation Talks (SALT) and the comprehensive test ban. In March 1978, the government was predicting that a comprehensive test ban would be concluded by the end of that year. The HASC subcommittee found disagreements within the US Government over such positions as duration of the agreement (and, if of fi-

nite duration, the question of what would be the conditions for resumption of testing), the kinds of tests or experiments (if any) our scientists would be allowed to carry out during the CTB, the effect of test restraints or a total ban upon the reliability of our nuclear weapons stockpile, and the US capability for monitoring test-ban compliance by the Soviet Union.³

This monograph seeks to broaden the discussion of nuclear testing to include all the fundamental issues involved, and to foster a better understanding of the effect of various test limitations or a total test ban on national security.

NOTES

1. The Department of Energy provided the following totals on underground testing to the House Armed Services Committee (HASC) in early 1979:

	1973	1974	1975	1976	1977	1978
USSR	14	8	10	10	11	20
US*	19	18	16	16	12	12

*Totals include 4 UK. SOURCE: HASC 96, p. 230.

An indication of the level of test activity in 1979 is provided by the following story from the *Baltimore Sun* of 13 February 1980:

"Geneva (AP)—The Soviet Union conducted 28 underground nuclear tests in 1979, the most ever in one year by any country, the Swedish delegate to the 40-nation disarmament talks said yesterday.

"Swedish Undersecretary of State Inga Thorsson said the tests were recorded by the National Swedish Seismic Observatory.

"The United States reported 15 nuclear tests during the year, all in Nevada, a figure close to its annual average over

the past decade, she said. The Soviet average during the decade was 20 tests a year.

"France last year conducted nine underground tests on the Pacific Island of Mururoa, the most it has held in a year, Mrs. Thorsson said.

"Britain exploded one nuclear device at the American test site in Nevada, while China—for the first time since 1970—conducted no nuclear tests."

While American nuclear testing was being allowed to continue only at an average level, Soviet testing in 1979 was at an all-time high! But Carter policymakers never questioned the Soviet Union about keeping its commitment in the 1974 Threshold Test Ban Treaty that it would keep the number of its nuclear tests to the minimum. Thus, US policymakers became the apologists, accepting that any level of nuclear testing the Soviet Union chooses is its minimum requirement!

2. According to PL 87-297, *Arms Control and Disarmament Act*, 26 September 1961:

"The terms 'arms control' and 'disarmament' mean the identification, verification, inspection, limitation, control, reduction, or elimination, of armed forces and armaments of all kinds under international agreement including the necessary steps taken under such an agreement to establish an effective system of international control, or to create and strengthen international organizations for the maintenance of peace."

3. US, Congress, House, Armed Services Committee, HASC 95-89, Panel Report, 13 October 1978.

III. NUCLEAR DISARMAMENT AND NUCLEAR DETERRENCE

Can a comprehensive nuclear test ban, justified as "progress in nuclear disarmament," be reconciled with the US national security doctrine of strategic nuclear deterrence?

The "Carter round" of test-ban negotiations should be understood in the overall context of US nuclear arms control and disarmament policy.¹ The dichotomy between that policy and our military strategy of nuclear deterrence is apparent in the projections of our nuclear forces into the next century. But our government has, for years, also professed a desire to move toward nuclear disarmament; and in that evolution a total, or "comprehensive" ban on nuclear explosive tests has come to be regarded as one, if not *the*, essential first step in the nuclear disarmament process. A special United Nations (UN) report on the comprehensive test ban describes it as the "litmus test" for the seriousness of the nuclear weapon states about nuclear disarmament.²

Some would argue that the objective of banning nuclear tests is the modest one of arresting the nuclear "arms race" and "strategic" competition between the superpowers. But this is just a variant of the basic dogma of nuclear disarmament, which holds that the eventual goal of disarmament must be approached by stabilizing and ceasing the "arms race," followed by eventual arms reductions, and then total disarmament. The situation may be compared to a ball rolling up an incline. If you want it to roll back down, you must decrease the forward and upward motion until it reaches stasis. Only then can the downward motion begin.

Fear of radioactive fallout in the atmosphere was the principal motive for the 1963 Limited Test Ban Treaty. But that treaty's preamble stridently argues for nuclear disarmament and against the "arms race." Similar language in subsequent international agreements has impelled US policymakers to pursue test-ban negotiations.

NUCLEAR DISARMAMENT NEGOTIATIONS

The United States has repeatedly pledged to achieve nuclear disarmament since 1963. Within the relatively unnoticed multilateral negotiations and consultations in such forums as the Conference of the Committee on Disarmament (CCD) in Geneva—now reconstituted as the forty-nation Committee on Disarmament—the United States has made that pledge official policy. Each autumn extensive negotiations are held in the UN General Assembly First Committee, which, as a result of decisions in the Special Session on Disarmament (SSOD), is now devoted exclusively to disarmament questions. About forty, separate disarmament resolutions were voted in the 33d UN General Assembly (1978).

Although agreements negotiated within the Committee on Disarmament have not been noteworthy since completion of the Non-Proliferation Treaty (NPT), future multilateral negotiations will have more importance because of greater activity and influence of non-aligned states. In 1980, Third World pressures resulted in two major US concessions. Reversing sound, long-standing policy, we acquiesced in the establishment of both chemical weapons disarmament and CTB working groups in the Committee on Disarmament.

As outlined in table 1, there are several important proposals for nuclear arms control and disarmament. The majority of the issues listed are receiving active consideration in various bilateral and multilateral negotiations. We need to recognize that arms-control theorists expect that agreements such as these will increasingly be substituted for actual military capability, just as in the case of the Antiballistic Missile (ABM) Treaty.

The traditional espousal by the United States of nuclear disarmament made it impossible to reverse course at the United Nations to avoid the pressures brought by the Soviet and Third World Blocs for holding a Special Session of the General Assembly devoted to disarmament. The "product" of that special session in 1978 was a "Final Document" consisting of three major parts: a "Declaration on Disarmament" containing sixteen "principles" for arms-control and disarmament negotiations, a "Programme of Action" for the international community to take to achieve general and complete disarmament, and a section on multilateral disarmament negotiating "machinery." The Final Document clearly sets nuclear disarmament as the priority for the future. The United States joined in consensus

Table 1. Multilateral Nuclear Arms Control and Disarmament

Policy

United Nations Special Session on Disarmament Final Document

- Principles for Negotiations
- Program of Action
- Primacy of Nuclear Disarmament

Security Assurances for Nonnuclear Weapon States*

- No First Use
- Qualified Prohibition on Use

Reduced Blast/Enhanced Radiation Weapons*

- Comprehensive Prohibition

Issues

Nuclear Non-Proliferation

- Horizontal—Additional Nuclear Weapon States**
- Vertical—Additional Development/Deployment by Nuclear Weapon States

Nuclear Weapons Free Zones

- Latin America
- Africa
- Mid-East
- South Asia
- South East Asia
- "Nordic"
- Mediterranean

Strategic Arms Limitation Talks

- Reduce and Constrain Certain Nuclear Delivery Vehicles

Cessation of Production of Nuclear Weapons

- Reduction of Inventories

Comprehensive Test Ban*

- Nuclear Explosive Technology
- Stockpile Reliability
- Nonproliferation Role
- Deterrence and Disarmament
- Verification

Non-Stationing of Nuclear Weapons*

- Ban From Places Not Previously Located

Cessation of Production of Fissionable Material for Weapons Purposes

- Transfer to Peaceful Use

*Soviet Draft Treaty Provided

**The UN recognizes five "nuclear weapon" states: US, USSR, UK, France, China.

Source: United Nations

adoption of the Final Document by the UN General Assembly, strongly supporting its statements on nuclear disarmament as reflective of, and consistent with, US policy.

Further, the idea of strategic deterrence, which for us is inextricably tied to nuclear capability, was specifically repudiated. The Final Document, citing the potential nonproliferation benefits of CTB, urges that negotiations be swiftly concluded "and the result submitted for full consideration by the multilateral negotiating body with a view to the submission of a draft treaty to the General Assembly."³

Statements contained in the Final Document cannot be dismissed merely as extreme cases of arms control rhetoric. As table 1 shows, nuclear arms control and disarmament is a broad and active field.

TEST-BAN OBJECTIVES

Although government pronouncements are, of course, subject to change, statements about the objectives of banning or limiting nuclear testing reveal consistent themes.

Former President Carter, in outlining his nuclear disarmament policy to the General Assembly, revealed how consistent:

The United States is willing to go as far as possible, consistent with our security interest, in limiting and reducing our nuclear weapons. On a reciprocal basis we are willing now to reduce them by 10 percent, by 20 percent, even by 50 percent. Then we will work for further reductions to a world truly free of nuclear weapons.

My country believes that the time has come to end all explosions of nuclear devices, no matter what their claimed justification—peaceful or military.⁴

Arms Control 1977, the official report to the Congress covering President Carter's first year in office, describes the objectives of a CTB, calling it a major contribution to curbing nuclear arms competition by "freezing" nuclear weapons technology and constraining further improvement in existing nuclear weapons stockpiles."⁵ In addition, it suggested a CTB could be "expected to improve the climate for a reduced reliance on nuclear weapons throughout the world by

demonstrating that the nuclear powers are committed to nuclear arms control." Finally, it concluded that any treaty attracting numerous adherents among nonnuclear weapon states would encourage nonproliferation.

Presidential objectives for CTB, before Carter, emphasized verifiability. President Nixon's arms control report to Congress in 1972, during a period when we were not actively negotiating on a comprehensive test ban, pointed out the "long-standing" US support for a CTBT which could be adequately verified:

The last four Presidents have stated that it is an object of US policy to achieve an adequately verified ban on all nuclear weapons tests. . . . The United States views establishment of a comprehensive test ban as yet another means for restraining the nuclear arms race and inhibiting the spread of nuclear weapons to additional countries.⁶

Military views on CTB are reflected in the Fiscal Year (FY) 1981 posture statement of the Chairman of the Joint Chiefs of Staff. According to Joint Staff analysis, the CTBT

can serve US interests if it is adequately verifiable, allows necessary nuclear testing for weapons design and stockpile reliability, and does not lead to the development of strategic asymmetries. At the current state of CTBT negotiations, these essential requirements have not been fully satisfied.⁷

The caveat of adequate verifiability is a familiar one, and not unique to military views on the idea of a test ban. The caveat that any treaty banning nuclear testing "not lead to the development of strategic asymmetries" is certainly desirable, but the problem is how to ascertain, in advance, that strategic asymmetries would not result from the test-ban treaty. Naturally, there would be objections if it were obvious, or provable in advance, that strategic asymmetries would occur. This appears to be happening with the ABM Treaty. Although the treaty itself is not "asymmetrical," some believe that it led directly to the deactivation of our only ABM system by undercutting political support in Congress for funding the operational system. The same logic applied to requested expenditures to maintain stand-by preparations to conduct nuclear tests during a test ban would be almost irresistible: Why fund a program the nation has a treaty against?

Another problem with the JCS statement of objectives of a CTB is that a "ban" is the antithesis of a measure that "allows necessary nuclear testing for weapons designs and stockpile reliability." If the real objective of US policy were to "allow necessary nuclear testing for weapons design," we would not be negotiating a CTB.

But the JCS statement is not the only place we encounter contradiction. The "Report of the Panel on the Strategic Arms Limitations Talks and the Comprehensive Test Ban Treaty of the Intelligence and Military Applications of Nuclear Energy Subcommittee of the House Armed Services Committee" recommends that "any such [CTB] treaty provide for weapons tests of sufficient yield to assure the reliability of US strategic and tactical nuclear weapons."⁸

To understand this contradiction, one must recognize that the debate is in reality about a test-ban treaty with a threshold different from the one we have already negotiated! The existence of such a contradiction suggests there is no consensus within our government on basic national objectives in the so-called "comprehensive" test-ban negotiations.

Apparently such confusion about objectives does not exist on the Soviet side. Their proposals have historically been for a ban on "weapons" tests only, as reflected in their draft treaty of 1977.⁹ The public descriptions of the current joint draft treaty do not depart from that format.

What can we conclude about the goals of a comprehensive test ban? Historically, it is clear that CTB is a key element of the broader policy of nuclear disarmament, as the SSOD Final Document makes clear. Since the comprehensive test ban would be the essential first step to nuclear disarmament, we must realize that the ban would also be the beginning of the end of our strategic nuclear deterrent.

TEST-BAN IMPLICATIONS

It should be obvious that all test-ban or limitation approaches are intended to undercut the nuclear weapons capability of the participants—directly or indirectly, long or short-term, unilaterally or multilaterally. Therefore, those who are advocating nuclear capabilities, such as the MX system, should not also be advocating nuclear test bans or limitations without taking into account the relationship

between the test restriction and its effect on the nuclear capability they promote.

The MX is an example worth considering because the system is expensive, designed to last for a long time, and very much in the public consciousness.

Nearly all discussions of MX assume its 2,000 warheads as simply "given." But few note that current nuclear testing policies raise immediate and long-term questions about the technical specifications and the reliability of warheads for systems such as the MX.

Despite clear statements of concern to the Congress by key officials, such as the nuclear laboratory directors, about the possible effects of a CTB on our nuclear stockpile, the "arms control impact statements" of the Carter administration contain no indication that a CTB would adversely affect or impede a variety of nuclear programs for strategic, theater, and tactical nuclear delivery systems. Instead, the statements raise concerns about defense programs affecting CTB! That the long-term question of nuclear deterrence versus nuclear disarmament is totally absent from the "analyses" contained in the arms control impact statements is perhaps the most convincing evidence that arms control has become—for a certain portion of the government bureaucracy—an end in itself, rather than a means to an end. It appears that future maintenance of the real operational capability of our nuclear deterrent force is someone else's problem, not the concern of full-time professional arms controllers.¹⁰

MX will absorb a huge *proportion* of defense resources for years to come. It is not "gold plating" to argue that, given the magnitude of investment, we should take *all necessary and prudent steps* to insure that the MX warheads are good enough when built, and kept as good as they can be throughout their operational life! Yet a CTB, even the "fixed duration" agreement now being touted, would change the whole basis for monitoring, modernizing, and planning for the nuclear weapons stockpile that has existed since World War II—with the exception of the 1958–61 test moratorium, during which weapons were produced that were subsequently found to have significant operational problems.

Some political leaders, such as Governor Brown of California, not only oppose nuclear electrical power but also extend their aversion to nuclear weapons and their delivery systems, and to the Los

Alamos and Livermore Laboratories, which have historically been managed by the Regents of the University of California. Governor Brown's agitation against these laboratories became of sufficient concern to Congress in 1979 that California Congressman Bob Wilson took steps to "emphasize the character of these laboratories as national laboratories." In offering an amendment to the Department of Energy (DOE) 1980 authorization bill that redesignated Los Alamos, Livermore, and Sandia as "national" laboratories, Wilson explained to the House of Representatives his concern:

The weapons laboratories at Los Alamos and Livermore are absolutely essential to the maintenance of the nuclear deterrent of the United States. They will remain essential for as long as world conditions require this country to have a nuclear weapons arsenal. These laboratories, with their sophisticated equipment, are national assets.

The management of weapons laboratories by the university is now strongly opposed by California's Governor, Edmund G. Brown Jr., and his position is supported by a considerable number of the regents themselves, and by a considerable number of the university's faculty.¹¹

A confluence of the movement opposing nuclear power with the nuclear disarmament movement would pose a formidable threat to the political basis of our nuclear deterrent posture. What is the national military strategy that drives the nuclear weapons need? What is strategic nuclear deterrence?

NUCLEAR DETERRENCE

General Russell E. Dougherty, US Air Force, Retired, former Strategic Air Command (SAC) Commander in Chief, emphasizes assured destruction as the "ultimate capability" of our strategic offensive forces—"offensive forces that, in the final analysis, serve as our primary instrument of defense." He continues:

The ability to assure devastating attacks on the attacker remains the cornerstone of our strategic deterrent. . . . We build options from that certain base—we never relinquish it.

But given that we can deter all-out nuclear attack with the threat of devastating an aggressor's principal cities and urban areas in retaliation, we must have the operational capabilities

to pose relevant deterrents to lesser forms of nuclear pressure, to consequential conventional attacks, and to intimidation or coercion.¹²

The continued commitment of the North Atlantic Treaty Organization (NATO) to a deterrent strategy linked to the US strategic nuclear deterrence capability is clearly manifested in the Final Communiqué of the North Atlantic Council Meeting with Heads of State and Government in Washington, 30–31 May 1978. After mentioning the diverse arms control negotiations—SALT, MBFR, and the SSOD—the communiqué asserts:

Until such time as it proves possible to achieve a satisfactory military balance at lower levels of forces through realistic and verifiable force reduction agreements, the Allies will continue to devote all the resources necessary to modernize and strengthen their own forces to the extent required for deterrence and defense.¹³

That is the basic rationale for adoption of the NATO Long-Term Defense Program (LTDP), which emerged as the result of decisions in 1977 to seek a more stable basis for NATO defense planning.

DETERRENCE—DISARMAMENT POLICY CONTRADICTIONS

Unfortunately, since the Eisenhower administration, US politicians and policymakers have tried to have it both ways—a strategy of nuclear deterrence along with a policy of declaratory nuclear disarmament. Since the days when Harold Stassen was Eisenhower's selection to head a special White House group to formulate US disarmament policy, we have been wrapped up in a national commitment to eventual nuclear disarmament.¹⁴

As recently as 1978, our country joined an "international consensus" that adopted the final Document of the UN General Assembly Special Session on Disarmament (SSOD) which, in excellent antinuclear rhetoric, sets forth demands that the United States along with the other nuclear weapon states undertake nuclear disarmament as a top priority.

The politics of the United Nations, especially the Third World politics of the General Assembly, dictate outcomes difficult, if not im-

possible, to reconcile with US security interests. In the case of nuclear weapons, a great dichotomy exists between our national strategy of nuclear deterrence, and the antideterrence and antinuclear rhetoric endemic within the Third World. The "consensus" reached at the SSOD in the Final Document leaves a major unresolved contradiction for the United States. The Third World nonnuclear weapon states are consistent in calling for nuclear disarmament; and the Soviet Union *appears* consistent in calling for nuclear disarmament.¹⁵ But when the United States calls for nuclear disarmament, it simultaneously declares its intent to abandon the key element of its national strategy upon which a force structure and political consensus have existed for over 30 years.

Our nation has been put—by its own leaders—in a difficult political position on the issues of nuclear deterrence and nuclear disarmament. It is hard to visualize how the US Government can continue, in the long run, to expect to receive political support for nuclear weapons and systems to provide for deterrence, while it simultaneously strives to curb nuclear power technologies, pursues agreements that would arrest both nuclear power and nuclear weapons technology, and subscribes to international initiatives for nuclear disarmament. It would seem a wiser course for our national leaders to seek to establish a politico-military consensus whereby we could continue to assure that nuclear technology will ~~always~~ contribute strongly to our national security posture in the broadest terms—of technology leadership, of weapons availability, and of energy independence from both Communist and Islamic tyranny.

Analyses by such distinguished strategists as Colin Gray and General Daniel Graham have examined the contradictions apparent in the US collateral doctrines of nuclear deterrence and nuclear disarmament. These strategists suggest that the Soviets have successfully exploited our doctrinal dilemma. Why, for example, should the United States negotiate, sign, and observe—but never ratify and implement the verification provisions of—the Threshold Test Ban Treaty and Peaceful Nuclear Explosions Treaty? Why should the "process" of negotiations take precedence over specific needs the United States may have to test over 150 kilotons, and the dismal Soviet record in keeping their side of the "gentleman's agreement" to observe the threshold and to minimize their testing? The observations by Gray and Graham that US policymakers, politicians, and other officials have operating upon them a Soviet-desired "personal incentive not to deny" their negotiated agreements is perhaps the most rational explanation yet advanced.

The "emotional investment" in the process of arms control described by Gray, and the "personal incentives operating on . . . officials not to deny their own handiwork" identified by Daniel Graham, perfectly describe the choice of Dr. Herbert York to succeed Paul Warnke in 1978 as head of the US delegation to negotiate a CTB with the Soviets and British. In 1958, according to Dr. Edward Teller's biography, Dr. York "sold out" the interests of Livermore Laboratory within 2 weeks after his departure for the Pentagon.¹⁶

In concluding his 1969 book about the "arms race" entitled *"Race to Oblivion,"* Dr. York strongly advocates unilateral disarmament initiatives:

Just as our unilateral actions were in large part responsible for the current dangerous state of affairs, we must expect that unilateral moves on our part will be necessary if we are ever to get the whole process reversed.

It may be beyond our power to control or eliminate the underlying causes of the arms race by unilateral actions on our part. Our unilateral actions certainly have determined its rate and scale to a very large degree. Very probably our unilateral actions can determine whether we move in the direction of further escalation or in the direction of arms control and, in the long run, nuclear disarmament.¹⁷

Policy views such as those of York gained supremacy during the 1970s, when the "process" of arms control and disarmament overwhelmed other objectives of national policy. This situation was manifested in the SALT II ratification testimony before the Senate Foreign Relations and Armed Services Committees, and in concomitant public statements and discussions during the second half of 1979. Even some prominent Senate *opponents* of the SALT II Treaty took pains to express their fealty to the "process" of arms control. Those who have consistently supported unilateral and negotiated measures of arms control and disarmament—such as former Senator Culver who exerted prodigious efforts to obtain cancellation of the B-1 bomber—raised as the last argument in favor of SALT II the threat of "a world without SALT."

Professor Richard Pipes of Harvard argues forcefully that Soviet strategy is successfully manipulating American attitudes toward nuclear "restraint" and "arms control." In "Soviet Global Strategy" he asserts:

Russia's growing nuclear arsenal inculcates in influential Western circles a sense of all-pervasive fear which induces a spirit of accommodation. Once the view gains hold that there is no defense against nuclear weapons, it becomes not unreasonable to advocate avoidance of disagreement with another nuclear power as the highest goal of foreign policy. The following sentiments expressed by Congressman Jonathan Bingham of New York are quite typical of this body of opinion:

"Above all, we must remember that the Soviet Union remains the world's only other superpower—the only country in the world capable of destroying us. Maintaining good relations with the Soviet Union must be our paramount objective."

I wonder whether Congressman Bingham has thought through the implications of his words.¹⁸

In February 1978, *Scientific American* remarked upon the degree of support among American scientists for the Union of Concerned Scientists' "Declaration on the Nuclear Arms Race," then being circulated throughout the scientific community. Listed among the 21 "sponsoring signers" are J. Carson Mark and Hans A. Bethe, who would advise the President in August 1978 that America does not need to test nuclear weapons in order to maintain its stockpile. The two "initiatives" supported by 12,000 scientists and engineers—including 27 Nobel Prize winners and 400 members of the National Academy of Sciences—are:

- A unilateral, uninspected moratorium on US nuclear weapons tests—an All-American CTBI
- A unilateral, uninspected moratorium on US tests of new nuclear weapons and new offensive and defensive delivery systems.

The architects of these "initiatives" say that—some time later—the Soviet Union would be expected to join in the moratoria. But they fail to explain—having stated that the Soviet Union cannot be expected to take these steps at the beginning—what would prompt the Soviet Union to join in later on.¹⁹

After Cardinal John Krol testified before the Senate Foreign Relations Committee in favor of SALT II ratification, he explained that

his presentation constituted the official position of the US Bishop's Conference, but did not represent all Catholics in the United States (only their leadership). In addition to support for the treaty and the "process," key "propositions" that summarize the US Catholic Conference testimony are:

Catholics reject means of waging war or even deterring war which could result in destruction beyond control and possibly a final holocaust of humanity.

Consequently, the reduction through negotiated agreements and, eventually, the elimination of such weapons, must be the overriding aim of policy.²⁰

Most of what Americans have thought of as "strategy" since World War II has been associated with nuclear weapons. The availability of a large arsenal of these weapons to all theaters of military operations has been taken as a "given" by our planners and strategists. But as demands for nuclear disarmament are increased, as the antinuclear sentiments of people around the world are stimulated, and as the "process" of nuclear arms control and disarmament becomes even more of an overwhelming driver of policy, the strategy of nuclear deterrence cannot coexist with the policy of nuclear disarmament.

Logic would dictate that, if the United States is going to keep a nuclear deterrent force, it would keep its weapons safe and reliable. That is, nuclear testing policy would follow, and be consistent with, our policy toward maintaining a nuclear deterrent arsenal.

However, the apparent logic of the situation has not prevailed. Since the early 1970s, the United States has followed a course that has made its nuclear testing policy hostage to the nuclear disarmament objective. We have cut back testing resources, restricted the nature and number of tests, and sought further restraints in the CTB regime. Those who support nuclear deterrence, and the logically needed improvement and modernization of that deterrent force over time, have been obliged to explain how the deterrent would facilitate arms control and disarmament. Perhaps it is time for those who favor nuclear disarmament to have placed upon them an onus to show what kind of military capability America will be substituting in the future for its nuclear deterrent forces, years into the CTB "regime."

NUCLEAR TESTING AND THE ARMS CONTROL PROCESS

In the myriad commentary surrounding SALT II, few observers have perceived linkage among what the United States is pursuing as nuclear deterrent policy—as manifested in the President's MX decision in 1979—the SALT II Treaty, and the nation's nuclear testing policy. In a short article that does address these linkages, Robert H. Kupperman and Donald Kerr (currently Los Alamos Director), commenting on the SALT II debate, list some "fundamentals" for negotiated strategic arms reductions. Their list includes the following:

We must not enter into any agreement which could be perceived to diminish the reliability of our nuclear forces or which could foreclose technological or policy options which could be important in future nuclear arms reduction agreements.

We must develop and maintain a diverse stable of weapons including both warheads and delivery systems to hedge against an unexpected technological breakthrough.²¹

In consonance with these fundamentals, Kupperman and Kerr propose that we continue a basic policy of seeking "deep" strategic arms cuts, but qualify that with the proviso:

Throughout the continuing arms reduction process we must keep our technological options open. We may need new weapons systems, and new nuclear warheads may be required. A Comprehensive Test Ban Treaty (CTB) could foreclose viable SALT options of the future and foster strategic instabilities. CTB should be indefinitely postponed.²²

Kupperman and Kerr's suggestions have the distinction of taking into account not only the policy imperative that the "process" of nuclear arms control and disarmament continue, but also the known needs of our nuclear weapons establishment.

Warheads, new or existing ones, cannot be taken as "givens." We cannot take their continued reliability and availability for granted. There is no foreseeable cessation of Department of Defense (DOD) requirements that the DOE nuclear weapons complex modify or adapt nuclear devices to new or modified delivery systems. Therefore, it would be an irremediable national blunder to allow misplaced dedication to the "process" of arms control and disarmament to crit-

ically compromise the only means we have to keep our nuclear weapons design, test, development, and production viable for the future. Weapons that cannot be tested, built, deployed, employed, or maintained—cannot deter.

NOTES

1. As distinct from earlier rounds of test-ban negotiations, such as the one leading up to the LTBT in 1963.
2. United Nations, CTB report, April 1980.
3. United Nations, General Assembly, S-10/2, *Final Document of the Tenth Special Session of the General Assembly*, 13 July 1978, p. 12, para. 51.
4. *Washington Post*, 5 October 1977.
5. *Arms Control* 1977, p. 14.
6. US, Arms Control and Disarmament Agency, *11th Annual Report*, pp. 13, 14.
7. US, Department of Defense, Joint Chiefs of Staff, *JCS FY 81 Report*, p. 39.
8. US, Congress, House, Armed Services Committee, HASC 95-89, *Panel Report*, 13 October 1978.
9. United Nations, Conference of the Committee on Disarmament, CCD/523, 22 February 1977, Union of Soviet Socialist Republics, *Draft treaty on the complete and general prohibition of nuclear weapon tests*.
10. The bureaucratic justification for the content of the arms control impact statements is that the law only requires analysis in the direction of program-to-negotiations. In interagency discussions in the past, ACDA officials have emphasized this pretext as the reason they do not have to mention detrimental effects of a CTB on our weapons programs, such as the effect on the stockpile. According to the method of analysis used, if a program requires a nuclear warhead in order to proceed, that requirement should be questioned in order to lay groundwork for a CTB to be negotiated.

11. US, Congress, House, *Congressional Record*, 9 November 1979, H10488.

12. General Russell E. Dougherty, USAF, "Strategic Deterrence and the Strategic Air Command," Air War College Associates Program, Air University, Maxwell AFB, Alabama, 1976.

13. Final Communiqué, North Atlantic Council Meeting with Heads of State and Government, Washington, DC, 30-31 May 1978. In *Atlantic Community Quarterly* 16 (Summer 1978): 243.

Note: The foregoing quotations which depict *existing* US strategy and other references throughout this paper to *what is*—should not be interpreted as meaning agreement with existing US strategy. The point is that a comprehensive nuclear test ban undermines nuclear deterrence whether one agrees with that particular strategy or not.

14. For detailed background and description of events of this period, particularly as they related to the nuclear test-ban issue, with a detailed chronology of events, see Earl H. Voss, *Nuclear Ambush: The Test Ban Trap* (Chicago: Henry Regnery Company, 1963).

15. Although there appears to be growing awareness of the boom in Soviet nuclear capabilities during the SALT "arms control" regime, by and large Soviet military programs remain unexamined under the gaze of "world opinion." So while the same contradiction *exists* for the Soviet Union, there is no political pressure upon Soviet programs to resolve the contradiction and no discernible effect upon their diplomacy.

16. Stanley Blumberg and Gwinn Owens, *Energy and Conflict: The Life and Times of Edward Teller* (New York: G. P. Putnam's Sons, 1976), p. 405:

"In March 1958, the director of Livermore, Herbert F. York, was asked to assume an important post in the field of his first love, space exploration. He left Livermore and went to Washington as Assistant Secretary of Defense/Research and Development. (Ernest O.) Lawrence and Teller had enthusiastically recommended York for the job, but, according to Teller, 'Herb got the job and within two weeks he sold us out. He was for nuclear weapons up to the day he went to Washington, and never after.'"

17. Herbert F. York, *Race to Oblivion: A Participant's View of the Arms Race* (New York: Simon and Schuster, 1970), p. 228.

18. Richard Pipes, "Soviet Global Strategy," *Commentary*, April 1980, p. 31. (Emphasis added.) In his brochure written for the Committee on the

Present Danger, 17 September 1979, entitled "Why the Soviet Union Wants SALT II," Professor Pipes concluded:

"SALT serves to create in the United States a political atmosphere obstructive to defense expenditures. SALT persuades much of the American public that any improvements in strategic forces are 'destabilizing.' SALT inhibits the US Government from funding weapons programs presumptively subject to becoming limited or even prohibited in later negotiations.

"All these features of SALT are inherently beneficial to the Soviet Union. It likes to depict SALT as the linchpin of detente, as it depicts detente as the only alternative to nuclear holocaust."

Professor Pipes cites Congressman Bingham's opinion as "quite typical" of a body of opinion; and there are abundant additional expressions of the same view by other members of Congress.

19. *Scientific American*, February 1978, p. 76. Has the attitude of scientists done a quick change since the Soviet move into Afghanistan, and the US response? Not according to the results of the 1980 annual meeting of the American Association for the Advancement of Science. See editorial by William D. Carey in *Science*, 8 February 1980.

20. Cardinal John Krol, "SALT II and the American Bishops," in *America*, published by the Jesuits of the United States and Canada, 8 March 1980, pp. 183-85.

21. Robert H. Kupperman and Donald M. Kerr, "Comment: SALT II—Another Point of View," *The Washington Quarterly*, Autumn 1979, pp. 149-51.

22. Ibid.

IV. MONITORING NUCLEAR TEST ACTIVITY

The single most important fact in test-ban monitoring is that, in terms of yield monitoring capabilities, a treaty can never be "comprehensive." A monitoring "threshold" will always exist even if the treaty structure is defined and accepted as a total ban—considerable evidence indicates this inescapable aspect of a CTB.

Monitoring a yield threshold differs from monitoring a ban: monitoring a threshold requires not only detecting and identifying what is happening, but also determining the magnitude of the yield to compare with the threshold yield; monitoring a ban requires detecting and identifying every nuclear explosion regardless of yield, to include even microscopic or so-called laboratory-scale events or experiments. Lacking such a detection capability, our government is unaware of whether or not a ban really exists, and the purported "ban" thus becomes a charade. This leads to the argument about the "military significance" of low-yield tests or experiments. Some argue that because nothing important can be tested at low yields, we can live with less than perfect monitoring capability.¹ But this argument does not explain why people oppose a threshold keyed to our actual monitoring capability. It is hard not to conclude that many total test-ban proponents perceive benefits in calling all US nuclear tests to a halt, whether other nuclear weapon states fully comply or not.

MONITORING ARRANGEMENTS

Senator Church's report to the Senate Foreign Relations Committee in 1978 indicated that one of the three issues under discussion in the CTB talks was "the extent and characteristics of the proposed national seismic station network to be implanted in each country to assist in verification of compliance."² (The other two issues are duration and on-site inspections.) The Soviets sometime in 1978 accepted "in principle" the "concept" of a national seismic station (NSS) network of tamper-proof stations, but their numbers and technical features are still being negotiated:

According to experts, outside detection equipment plus the stations would make it very risky for the Soviets to test above 1 kiloton in some places, or test at all in other places. The risk

of detection would be tremendously increased by these stations, and their deployment would make it extremely doubtful that the Soviet Union could get by with a pattern of clandestine testing which would have any *military significance*.³

Testimony by Mr. Ray E. Chapman of the Department of Energy before the House Armed Services Committee Procurement and Military Nuclear Systems Subcommittee in March 1979 describes monitoring arrangements being developed for the CTBT:

The current negotiations indicated the United States could emplace [deleted] NSS within the Soviet Union. However, to insure that the United States can meet the production and installation schedule within the expected duration of the treaty, the fiscal year 1980 budget request contains funds to produce five such stations. These will cost \$1.1 million each.⁴

According to Chapman, some national seismic stations were to be deployed in 1980 in the western United States and Alaska for test and research purposes. Throughout 1979, according to the President's Arms Control Report to Congress, the United States emphasized disclosure of data on US seismic monitoring technology in order to encourage progress in the CTB negotiations.

The assertion that improved seismic monitoring will provide better capability is a historical argument for "adequate" CTB verification. For the last 20 years various "breakthroughs" or vast improvements in seismic means have been cited in testimony to the Congress as providing sufficient assurance to the United States to enter into a CTBT.⁵ The salient comparison, however, is not with previous claims of the seismological scientists—many of whom have been working on CTB for years⁶—but with the track record in monitoring Soviet compliance with the Threshold Test Ban Treaty (TTBT). That treaty essentially entered into force in April 1976. Although it has not been ratified by the Senate, it is binding upon DOD and DOE planners in carrying out our nuclear testing program, and has been since the "magic" date of 31 March 1976.⁷

The task in the TTBT is not only to detect and identify nuclear events in the Soviet Union, but also to determine the yield for comparison with the threshold of the prohibition. Although some could argue that we do not need—because of the TTBT—to monitor at the low levels of yield that we would under a CTBT, for intelligence purposes we need to monitor as low a level of Soviet yields as possible.

But our "totals" on Soviet tests cut off at certain yield levels, depending upon assumptions about the locations of the tests and the timing of the events by the Soviets.

Controversy has occurred over Soviet compliance with the TTBT even though the yield threshold is "deplorably" high—150 kilotons. Congressman Melvin Price indicated the uncertainty about Soviet compliance with the TTBT in a *Congressional Record* entry criticizing the offer of the State Department to provide a classified briefing in response to a question about Soviet test-ban compliance.⁸

MONITORING THRESHOLDS

The issue of CTBT monitoring thresholds for seismic detection was addressed specifically by former Defense Secretary Brown in response to questioning by Senator Nunn at hearings before the R&D Subcommittee on the Senate Armed Services Committee:

Senator NUNN: On the subject of CTB, do you have confidence that we have the ability with our intelligence resources to verify Soviet compliance with the zero yield comprehensive test ban?

Secretary BROWN: We surely will not be able, by seismic means, to detect yields much less than (deleted). Now there are other means involving other intelligence methods that could tell us something and could deter the Soviets from carrying out tests at yields that we couldn't detect seismically, but *there is always going to be some yield below which the risk of detection would be quite low*. The issue is how important and how useful are such yields, how necessary from a military point of view? [Emphasis added]⁹

Although the specific yield figure is deleted in this and subsequent discussion, it is irrelevant to the essential "fact of" an existing yield threshold. If such a threshold exists, then the "CTB" is not "comprehensive," but is only a variant of the threshold treaty concept. And the question of "military significance" of below-threshold activity is not a simple one to resolve, as section 5 discusses in detail.

Another answer to the same question of Senator Nunn as above, submitted by the Department of Defense for the record, also concedes the existence of a threshold:

ANSWER: Presently, and by seismic means alone, we can detect at known Soviet test sites fully tamped underground nuclear explosions down to [deleted]. In seismic regions, the effective seismic monitoring *threshold* for tamped explosions is [deleted].

*As a practical matter, however, there is always going to be some yield below which the risk of detection is quite low. Aside from the open question of whether or not an evader would actually assume such a risk, the adequacy in verifying a CTBT should be judged by how important, how useful, and how necessary such yields are from a military point of view. [Emphasis added.]*¹⁰

The last paragraph of this answer raises a spectre of "risk" the Soviets would entail of our detecting their "deleted" yield-test activity, and then immediately proceeds to suggest any tests at or below "deleted" yield would be "militarily insignificant" anyway. However, if we consider below-threshold yields militarily insignificant, why should the Soviets expect us to react to their testing at those yields? If we do not care, wherein lies the risk to the Soviets?

ON-SITE INSPECTIONS

"Voluntary on-site inspections,"* basically a Soviet phrase, became popular in arms control usage after the Soviet initiative in late 1976 in the UN General Assembly to promote "voluntary" on-site inspections (OSIs) to create movement in CTB negotiations. At that time, the Soviet political gambit on "voluntary" OSIs was based on the possibility that Carter would win the election. Given his stance on CTB, the Soviets felt he would be especially amenable to a gesture that could be interpreted as a Soviet "concession" to get a CTB.

In several statements to the CCD, the Soviets have described in detail their position on "voluntary" OSIs. They often compare OSIs for CTB compliance with the "voluntary cooperation and consultation" ideas embodied in other agreements, such as the Biological Weapons Convention (BWC) and the Environmental Modification (ENMOD) Convention, which was ratified by the United States and entered into force for us on 17 January 1980. These agreements

*Also frequently referred to in arms control vernacular as "challenge" OSIs.

have received relatively little publicity in our country.¹¹ Even their proponents do not argue that they provide strong compliance monitoring provisions. However, the Soviets are in a position to take advantage of these as precedents in being of international arms control agreements that were *acceptable* to the United States, although verifying the compliance of other states is difficult if not impossible! While such an argument may have little impact in the US Congress, it is much more difficult for the United States to counter it in multilateral forums, such as the Committee on Disarmament and the UN General Assembly. But the United States could never use "voluntary" OSIs to obtain information about either Soviet conduct or compliance regarding nuclear test restrictions which the Soviets did not willingly decide to disclose.

It is unfortunate that the OSI provisions of the test ban emerging from the Carter round of negotiations will not be as strong as the provisions for on-site inspections in the Peaceful Nuclear Explosions Treaty (PNET), which the Soviets have already signed! Article IV of the PNE Treaty provides for mandatory on-site inspections of certain declared events. According to recent DOE testimony by Mr. Ray Chapman:

The ... PNET gives the United States the right to carry out on-site inspections of some kinds of Soviet PNEs in order to assure ourselves that they are not disguised weapon tests.

To be ready for such inspections, we have developed and maintained specially designed equipment for on-site measuring of explosive yield and other characteristics of nuclear explosions.¹²

DATA EXCHANGE

Mr. Chapman's testimony also describes an anomalous situation that has developed under the Threshold Test Ban Treaty on monitoring capability. One important provision of the treaty is a protocol "which details technical data to be exchanged and which limits weapon testing to specific designated test sites to assist verification."¹³ According to an official description of that treaty:

The data to be exchanged include information on the geographical boundaries and geology of the testing areas. ... After an actual test has taken place, the geographic coordinates of the test location are to be furnished to the other party, to

help in placing the test in the proper geological setting and thus in assessing the yield. . . .

The treaty also stipulates that data will be exchanged on a certain number of tests for calibration purposes.¹⁴

The data exchange features of the TTBT, along with the OSI provisions of the PNET, were touted by some as "breakthroughs" in nuclear test limitation negotiations, and indicative of "a significant degree of direct cooperation by the two major nuclear powers." However, in responding to a committee question about obtaining geophysical data on the Soviet Union, Mr. Chapman pointed out that "the Threshold Test Ban Treaty requires the geophysical characteristics and geology of the nuclear weapon test sites in the Soviet Union. *We have not yet received that data package, however, since the treaty has not been ratified.*" (Emphasis added.)¹⁵

It seems incredible the United States would negotiate a treaty with the Soviet Union, and observe its provisions, but not ratify the treaty because of a policy decision to press for an agreement more challenging to verify. What results is an inability to obtain data the Soviets have already agreed to provide that could enhance our ability to monitor a lower threshold agreement!

Although the Soviets would decide which events to declare, the Threshold Test Ban Treaty provides for notification of certain tests and exchanges of scientific data for calibrating test surveillance equipment against known yields and geologies. Because of the unseemly haste in moving for a so-called comprehensive ban in the Carter round, the TTBT provisions have never been implemented because the United States has bypassed ratification of the TTBT. Herbert York, when chief of the US CTB delegation, indicated something akin to despair that the TTBT monitoring and compliance-enhancing provisions could be incorporated into the CTB.¹⁶

VERIFICATION POLICY

The House Armed Services Committee Panel on SALT and CTB Report of 13 October 1978 is highly critical of the US verification posture in the CTB negotiations. The Panel Report, based upon several days of hearings and time spent with the CTB delegation in Geneva, concludes:

The United States today can probably detect most 5 to 10 kiloton nuclear explosions which occur in the normally used Soviet testing areas, which are in the aseismic regions of that country. . . .

Department of Energy and Department of Defense witnesses have testified that several run-of-the-mill tests per year up to 10 kilotons would provide ample confidence of the viability and reliability of currently stockpiled weapons. Within that restricted number of tests and yield limits, experienced designers could also prove the adaptability of new concepts for new weapons, tactical as well as strategic.¹⁷

The Committee Panel Report emphasizes that much of what has been said about CTB verification amounts to mere assertions, without technical fact or substance to back them up.

Evolution of the verification issue in connection with SALT has led to the "adequate" school of thought. This school advances the idea that monitoring capability is adequate and acceptable for national security purposes if it provides sufficient warning of noncompliance by other parties to an agreement for the United States to take timely counteractions to forestall development of any "strategic asymmetries." Lieutenant General Daniel Graham (US Army, Retired) analyzes the shift to the concept of "adequate" verification—and the link between that concept and intelligence support to negotiations and compliance assessments. His thoughts shed more light on the subject than much of the testimony on SALT II verification contained in the SALT II ratification hearings. General Graham, former Director of the Defense Intelligence Agency and one of the most qualified experts in the United States to speak on this issue, summarizes:

A new outlook on verification became vogue in [Carter] administration statements on the subject. Verification was described as adequate if "cheating on a scale large enough to alter the strategic balance would be discovered in time to make an appropriate response." . . . Verification used to be "adequate" if US intelligence had high confidence (never total confidence) that Soviet attempts to circumvent the treaty provisions would be detected—*period*. . . .

The new concept of verification, however, includes two very subjective aspects: the scale of cheating that would upset the "strategic balance" and the time required for the United States to make an "appropriate response."¹⁸

Who decides when Soviet cheating becomes severe enough to upset the "balance"? One suggestion is that the Joint Chiefs of Staff be made responsible by law for exercising their military judgment to decide the question.

BANNING FUSION TECHNOLOGY

An outright ban on nuclear testing would prohibit the United States from conducting research to advance technology that *in itself* tells us what might be expected in the technological achievements of others. The question of "banning" research activities—the "book burning" mentality frequently encountered among arms control zealots—is a profound one going well beyond the issue of nuclear testing.* The so-called pure fusion weapon is an example of the problem of banning research. That such a weapon is a possibility cannot be technically ruled out, or ruled in, based upon our present knowledge of the fusion process. That is to say, we cannot exclude it ever coming about on the Soviet side, nor can we plan upon having it as a military capability for ourselves for the future. Third World countries participating in advanced fusion research are also plausible candidates to "crack" the secret of pure fusion.

The military importance of pure-fusion weapon technology lies not in the possibility of much bigger warheads, but much smaller ones! Fusion reactions for inertial confinement fusion (ICF) experiments are started by immensely powerful and energetic triggers, or drivers, such as high-energy lasers. Fusion reactions in weapons are triggered by fission explosions. But, in principle, if it were possible to set off a fusion explosion in a small amount of fusionable material by using the energy from high explosive, a weapon such as a hand-grenade yielding in the range of tons of TNT equivalent could be imagined.

In 1977 House Armed Services Committee testimony, Dr. C. Martin Stickley of the Energy Research and Development Administration (ERDA) pointed out that "basically, the effort in laser fusion is one of trying to miniaturize or greatly reduce the amount of energy that is needed to set off a deuterium-tritium reaction."¹⁹ This suggests the possibility that large drivers, such as a fission bomb or a terawatt-scale laser, could someday be supplanted by a smaller

* This question is discussed further in section 5.

power source, for example high explosive, depending upon what is learned as ICF technology progresses.

The potential effect on warfare of such a technological development would be revolutionary. The problem if the United States unilaterally abstained from fusion technology-advancing research and the Soviet Union did not is apparent. In a decade, we would not be in a better position than we are today to judge the likelihood of the Soviets' having pure fusion weapons. If they were to continue to develop their pure fusion technology below the threshold of monitoring, we would not have the benefits of additional information from our own research to use in making our judgments about them.

Samuel T. Cohen, nuclear weapons designer and consultant, gives credence to the possibility of Soviet advances in the field of pure fusion technology:

The first country to begin the investigation of pure fusion explosives was the USSR. In 1952, the Soviets initiated experiments in which a charge of high explosive was detonated to compress and heat very small amounts of heavy hydrogen. The attainment of nuclear yields up to ten tons of TNT equivalent was envisaged and in these early experiments the Soviet scientist L.A. Artsimovich reported that nuclear reactions ... were detected.

We do not know what success the Russians had with this program, since more than 20 years ago they stopped reporting openly on it. However, were they, for example, actually to have achieved the capability to produce ten-ton yield pure-fusion neutron warheads a most useful tactical weapon would have been at hand. Such a weapon would be extremely cheap in terms of critical nuclear materials; extremely flexible in its ability to be used without causing significant damage to civil structures; and highly effective against invading enemy armies—disabling military personnel (with neutron radiation) over an area of about one-quarter million square yards.²⁰

The eminent scientist Wolfgang Panofsky states that "we must recognize that a pure fusion device has never been developed."²¹ We might ask how Panofsky, a CTB advocate, knows. Assuming he is referring only to the United States, Dr. Panofsky would need direct or indirect access to the specifics of what we have and have not been able to achieve. But what if he is also referring to the Soviets? Does he have access to their programs? Does he have inputs from

technical monitoring systems that tell him everything the Soviets are detonating at all levels of yield that would be applicable to developing pure fusion weapons? American scientists have told Congress that our existing high-power lasers are routinely generating thermonuclear neutrons as a result of laser fusion reactions. No public evidence is available suggesting that we are capable of monitoring what knowledge Soviet high-energy research lasers are producing.

Our intelligence on foreign nuclear technology has been adversely affected by 20 years of the atmospheric test-ban regime. Dr. Edward Teller describes the effect:

Following the 1961 test there were vigorous negotiations to prohibit further nuclear testing. . . .

What actually occurred was that nuclear testing in the atmosphere was banned. The consequences of that ban were not fully foreseen. Great ingenuity was shown in performing tests underground. When testing had gone on in the atmosphere, the products of explosions dispersed; they could be collected, and they yielded information about the nuclear activities of any country. Once testing was limited to underground, this source of information was lost.²²

Conclusions we draw today, reliant upon above-threshold knowledge of numbers of Soviet tests, are necessarily indirect. If the United States completely suspends experiments that advance nuclear explosive technology, either by restricting ICF experiments or by abandoning all underground nuclear explosions, it will eventually reduce our monitoring capability to only some raw numbers of Soviet above-threshold tests detected, and extrapolations back to Soviet technology as it was assessed in earlier times. Such limited capability will be totally inadequate for future security, a serious matter for those who advocate establishing a total test-ban regime. The technology they say should be abolished may, like a dormant weed, crop up at a later time with extremely undesirable consequences. Thus, the technology issue and the monitoring and verification issues in CTB are inextricably linked. This linkage presents a qualitatively different problem from the one of monitoring SALT compliance.

SOME MONITORING PROBLEMS

The principal existing agreement limiting nuclear test activity is the Limited Test Ban Treaty (LTBT), also known as the atmospheric

test ban or the partial test ban. Our means for monitoring this agreement include the atomic energy detection system (AEDS), along with other intelligence that can supplement seismic data, which may be either technical means or human-source intelligence. The dispute over the event registered by a Vela satellite on 22 September 1979 illustrates the gaps and uncertainties inherent in nuclear test activity monitoring.²³

Ever since Albert L. Latter demonstrated convincingly in 1958 that cavities in the earth could be used to "decouple" nuclear explosions and thereby foil seismic monitoring, the decoupling issue and its role in CTB monitoring has been controversial but unresolved.²⁴ Classification of information about Soviet testing prevents disclosure of how many (if any) Soviet tests in recent years might have been decoupled. Information is available from the Soviet peaceful nuclear explosives program indicating the Soviets have used nuclear explosions to create cavities in salt formations, which could be used for decoupling of subsequent tests.²⁵

The LTBT also "bans" nuclear explosions in the atmosphere, outer space, and underwater. Certain "safeguards" were provided at the time of US ratification of the LTBT to keep us capable of monitoring activity in all these environments. However, it would appear that US capabilities have either degraded or never developed, judging by the continuing question of whether or not an atmospheric nuclear detonation occurred on 22 September 1979 and, if one did occur, which nation was responsible. Since the LTBT left an outlet for nuclear testing underground, and since the known problems of radiation in the atmosphere provide strong practical incentive for compliance with an underground-test regime,²⁶ the need for a truly competent monitoring capability was less pronounced in 1963 than it is today, when the announced intention of the CTB is to in fact stop all nuclear testing.

Judging the adequacy of test-ban monitoring is essentially different from SALT monitoring because of the multilateral nature of a test ban. The Standing Consultative Commission (SCC), the official US/USSR ABM Treaty and SALT I compliance monitoring body, is of course strictly a bilateral forum. Such a closed-club atmosphere cannot be maintained in a multilateral CTB compliance-oversight body.

The International Seismic Data Exchange (ISDE) would be the multilateral aspect of the CTB monitoring effort. A number of discus-

sions held under the auspices of the Committee on Disarmament covering the technical aspects of monitoring a test ban have resulted in publication of a report by the "Ad Hoc Group of Seismic Experts." In the 1979 sessions of the Committee on Disarmament, the Soviet Union blocked attempts to expand the activities of the *ad hoc* group of seismic experts to sponsor international exchanges of data in anticipation of establishing a workable international system that could come into being at the time a test ban came into force.

This multilateral aspect of CTB monitoring is highly important, because it affects the willingness of nonnuclear weapon states to join a test ban. If the ISDE network were genuinely effective it might satisfy nonnuclear weapon states that they have a reasonable chance of knowing about violations by the nuclear powers; that is, they could be sure we had quit testing above whatever threshold the ISDE would provide. Then the nonnuclear weapon states would be more inclined to join a test-ban regime.

The arguments advanced to entice nonnuclear weapon states to join a test-ban regime, the credibility of which would be based upon seismic monitoring capability, are misleading to the extent that they ignore or downplay the issue of stopping the growth of nuclear weapons technology. The basic dilemma, previously mentioned, of having a declaratory ban but only a threshold monitoring capability would still exist. Therefore, the credibility of the test-ban regime will rest on the conviction with which nonnuclear weapon states can accept the proposition that the type of information nuclear weapon states can develop by testing at yields below the monitoring threshold are in fact "militarily insignificant." But any information we can get through research, such as inertial confinement fusion, enabling us, for example, to maintain a cadre of weapons design experts will be, *ipso facto*, militarily significant.

It is important that any arms control or disarmament agreement be tailored to be consistent with existing capabilities for monitoring of compliance, either explicitly or implicitly acknowledged. The CTB, as currently conceived, fails to meet this condition because the need remains to build up greater monitoring capability while the agreement is in force.

At present, we have neither a foolproof monitoring system, nor a real prospect that an error-free monitoring system will come into being in the foreseeable future. Yet, according to testimony before

Congress, CTB will inaugurate a new verification concept—that of bringing a treaty into force with prior stipulation that our monitoring means are *inadequate*, with an intention of upgrading them during the treaty.

In describing the role of the development of the engineering model of the US national seismic station in the context of the test-ban negotiations, Mr. Ray Chapman of DOE testified:

The aim is to demonstrate technical feasibility of regional seismic detection systems, to gain environmental performance data in the permafrost regions, and to conduct further research on regional seismic detection and discrimination technology.

Then, if we have a ratified CTBT, the stations could be either deployed in the Soviet Union or used within the United States for CTB verification, depending upon the final verification commitments of the treaty.

Dr. Morgan Sparks of Sandia Laboratories also testified:

Verification and arms control technology funding includes five national seismic stations which will be built while comprehensive test ban treaty negotiations are underway. If a CTB is negotiated, an additional five stations, plus two spares, would be needed.²⁷

So, a basic question is: can we enter into an agreement in the hope that some day in the future we will have sufficient monitoring capability? The question seems, by its very nature, to suggest the "needed" capability is exaggerated. If not, we could not live for years without it. If we could accept a delay early in the life of the treaty when we would have "insufficient" monitoring capability, then we could not effectively argue against further delay if it should be occasioned by Soviet obstinacy. The requirements are not balanced politically; even though there may be an effort—occasioned by Soviet demands—for an appearance of technical "symmetry" (in numbers of national seismic stations (NSS)).

The Soviets could essentially monitor cessation of nuclear testing in the United States by watching us zero out that portion of the DOE budget request, and then sending a journalist to witness the closing of the Nevada Test Site. The fact that they would concurrently demand installation of a group of "NSS" elsewhere within the United States (at more than one million dollars a copy to install) to

"prevent" us from surreptitiously detonating nuclear devices, on the grounds of "equality" in the treaty regime, should not fool anybody that their monitoring problem is equal to ours.

MONITORING AND TREATY STRUCTURE

The structure of the CTB treaty is another issue that needs to be considered in the context of monitoring capability. If we are in fact going to declare an official willingness to choke off the technology of nuclear explosives, then we need to address the growth potential of nuclear explosive technology allowed for by inertial confinement fusion (ICF) techniques. Clearly, ICF activities are below any conceivable seismic monitoring threshold. From the disclosures made to the Congress by ICF researchers, it is evident that the technique is interchangeable with progress in understanding basic phenomenology directly applicable to weapons technology. If our nation is going to continue to pursue ICF research in the move toward peaceful fusion power, we are also going to be in a position to advance our knowledge and understanding of the phenomenon of fusion. Thus, we would carry forward the kind of knowledge that can be applied to the design of nuclear weapons, along with understanding of nuclear explosive technology, within a cadre of highly qualified scientists who can continue the weapons effort under a variety of future scenarios for the continuation or noncontinuation of test restraints.

One conclusion could be to abandon ICF research! And as a nation, we may do that, just as we may abandon nuclear power altogether given certain political circumstances. But CTB, being a multilateral agreement, would require our convincing other nations to abandon inertial confinement fusion. It would also require structuring the CTB monitoring provisions to include the kind of provisions that permit on-site inspections of declared facilities in order to monitor compliance with a total ban that included inertial confinement fusion.

A US decision whether to cut-off or somehow restrict ICF research activity is an integral part of the comprehensive test-ban issue, as long as test-ban advocates continue to tout "freezing" or "capping" nuclear explosive technology as a prime objective and benefit of the CTB treaty.

To have negotiations aimed at nuclear weapons (as opposed to launchers) is feasible—as it is in the chemical weapons talks to fo-

cus on individual weapons. The nature of negotiations would have to change from the "remote control" monitoring concepts of SALT (and to date, CTB) talks, but it would be just as feasible to structure an agreement calling for declarations of stocks and facilities associated with nuclear weapons, as it is in chemical weapons disarmament negotiations. The key difference in approach in structuring such agreements is to move toward openness, declarations of stocks and facilities, and close cooperation including extended-duration, on-site monitoring by international authorities, as opposed to total reliance upon technical means of monitoring, such as surveillance satellites.

CTBT VERIFICATION PROVISIONS

In summary, while a nuclear test ban is bad for America even if the Soviets honor it, the kind of total prohibition insisted upon by many disarmament purists is unverifiable. However, the most recent US/USSR/UK public statement on the status of test-ban negotiations emphasizes verification.²⁸ The effort is not only to persuade a naive public that a total test ban can be effectively patrolled against Soviet cheating and deception; but also to convince people that our signing of a test ban will provide improved intelligence—the same verification argument advanced by the Carter administration for the SALT II Treaty. Plus, the Comprehensive Test Ban Treaty will contain more verification provisions than the SALT II Treaty.

The CTBT will speak of an international seismic data exchange, conducted and managed by a group of seismic experts who will constitute the world's first international disarmament compliance-monitoring organization. The joint US/USSR/UK statement announces agreement upon terms for conducting "voluntary" on-site inspections, which means the Soviets agree to permit, strictly on their own terms, visits by outsiders to the sites of suspected test-ban infractions within the Soviet Union. The scheme is similar in concept to the provisions for cooperative efforts to secure information about questions of compliance with the Biological Weapons Convention (BWC), and, as in BWC matters, the Soviets can be expected to take the position that they are innocent of any alleged violation until proven guilty. Provision of proof, of course, would necessarily require disclosure of our intelligence holdings on the matter to the Soviets.

The Comprehensive Test Ban Treaty will also provide for a separate verification agreement between the United States and the So-

viet Union only, similar to the Standing Consultative Commission established with the SALT I agreement and Anti-Ballistic Missile Treaty. Under terms of the separate verification agreement, plans will be announced to install national seismic stations (NSS) within the United States and Soviet Union that, it will be alleged, will so reduce the threshold of detectability of underground explosions that the Soviets would be too afraid of US censure to attempt to cheat on the test ban.

Despite the superficial technical gimmickry of the NSS scheme, the thrust of US verification capability under the comprehensive nuclear test ban will be away from satellite photography of large intercontinental missiles, and toward seismic monitoring measures that are in their technical essence ambiguous. That is, seismic monitoring cannot provide clear-cut, definitive answers.

Furthermore, CTBT verification will rely to a critical degree upon "consultation and cooperation" with the Soviet Union for there to be any hope of implementing even the technical monitoring measures. Yet, many test-ban advocates are willing to have this country sign, ratify, and begin observing a total test ban—and only then begin the lengthy process of surveying locations within the Soviet Union for installing the national seismic stations. During all this time—many experts believe the national seismic stations even if manufactured cannot be installed within the period of a 3-year treaty—the United States will have even less than what former President Carter considered "adequate" verification, and the Soviets will have the opportunity to arbitrarily procrastinate and obstruct improvement of our monitoring means.

Finally, to provide its reputed nonproliferation benefits, the Comprehensive Test Ban Treaty will be a multilateral measure, and the maximum possible participation by Third World nonnuclear weapon states will be sought. Because these states have been promised for years that the test ban will eliminate any vestiges of "discrimination" between nuclear weapon and nonnuclear weapon states regarding nuclear test explosions, the Third World states are being promised a voice and role in compliance monitoring that will politicize the verification process far beyond even that experienced in SALT.

NOTES

1. Two close observers of the test-ban debate, Leslie H. Gelb and Donald R. Westervelt, do favor beginning with TTBT and undertaking gradual reduction of threshold. See Gelb, "A Glass Half Full," *Foreign Policy*, Fall 1979; and Westervelt, "Candor, Compromise, and the CTB," *Strategic Review*, Fall 1977; "The New Test Ban Treaties: What Do They Mean? Where Do They Lead?" *International Security*, Winter 1977; "Can Cold Logic Replace Cold Feet?" *Bulletin of the Atomic Scientists*, February 1979.
2. *Strategic Arms Limitation Talks and Comprehensive Test Ban Negotiations*, Report to the Senate Foreign Relations Committee by Senator Frank Church, (sanitized and made public, September 1978), p. 12.
3. *Ibid.*, p. 13 (Emphasis added.)
4. US, Congress, House, Armed Services Committee, HASC 96-6, p. 215.
5. Bruce Bolt, *Nuclear Explosions and Earthquakes—The Parted Veil* (Berkeley: University of California Press, 1976), gives thorough historical background on the seismic monitoring question.
6. For example, Frank Press, who was President Carter's White House Chief of Science and Technology Policy, is a seismologist and was on the US delegation to the 1958 Geneva test-ban talks.
7. The Senate Foreign Relations Committee (SFRC) received testimony on ratification of TTBT and PNET in 1977. See *Threshold Test Ban and Peaceful Nuclear Explosion Treaties, Hearings before the Committee on Foreign Relations and the Subcommittee on Arms Control, Oceans and International Environment of the Committee on Foreign Relations*, US Senate, 95th Cong., 1st sess., 28 July, 3 August, and 8 and 15 September 1977 (Washington, DC: Government Printing Office, 1977). In a report to the SFRC dated 11 August 1978, Chairman Frank Church describes the handling of the PNET and TTBT and their status:

"In 1977, the Carter administration asked that the Committee take up the two treaties, and four days of hearings were held. On September 20, 1977, the Committee, unanimously by voice vote, ordered the two treaties favorably reported. Following further discussion a week later, the Committee decided to take no further action on the treaties at that time. As time passed, and the comprehensive test ban talks progressed, ex-

ecutive branch interest in action on the two treaties began to wane. It appeared doubtful whether the two treaties would be supported effectively if they came to the floor. Accordingly, on June 13, 1978, the Committee reconsidered the vote by which the treaties were approved and they were returned to the Committee calendar.

"As a result, the United States, Soviet Union, and Great Britain are now adhering to the terms of the Limited Test Ban Treaty of 1963, and the United States and Soviet Union are each conforming unilaterally to the terms of the TTBT, even though it has not been ratified. [Emphasis added.]"

8. US, Congress, House, *Congressional Record*, 5 September 1979, p. H7355.
9. US, Congress, Senate, *Impact of SALT on U.S. Military Research and Development, Hearing before the Subcommittee on Research and Development, of the Committee on Armed Services, 95th Cong., 2d sess., 8 June 1978* (Washington, DC: Government Printing Office, 1979), p. 19.
10. *Ibid.*, p. 45.
11. Revelations and controversy concerning the 1979 "Sverdlovsk Incident" have publicized the BWC more than ever before.
12. US, Congress, House, Armed Services Committee, HASC 96-6, p. 215.
13. US, Arms Control and Disarmament Agency, *Treaties on the Limitation of Underground Nuclear Weapon Tests and on Underground Nuclear Explosions for Peaceful Purposes*, ACDA Pub. 87, May 1978.
14. US, Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements*, ACDA Pub. 94, June 1977, p. 156.
15. US, Congress, Armed Services Committee, HASC 96-6, p. 222.
16. Herbert F. York and G. Allen Greb, *The Comprehensive Nuclear Test Ban*, Discussion Paper no. 84, California Seminar on Arms Control and Foreign Policy, Santa Monica, California, June 1979, p. 40.
17. US, Congress, House, Armed Services Committee, HASC 95-90, pp. 28-29.
18. Lieutenant General Daniel O. Graham, USA (Ret.), *Shall America Be Defended? SALT II and Beyond* (Arlington House, 1979), p. 219. General Graham's footnote refers to Department of State Special Report, "The Strategic Arms Limitation Talks," July 1978. Other key documents on verification are *Verification: The Critical Element in Arms Control*, ACDA Pub. 85, March 1976; Amrom H. Katz, *Verification and SALT—The State of the Art and the Art of the State* (Heritage Foundation, 1979); and Department

of State "Selected Documents No. 7, SALT ONE: Compliance, SALT TWO: Verification," Bureau of Public Affairs, 1978.

19. US, Congress, House, Armed Services Committee, HASC 95-15, p. 62.

20. S.T. Cohen, "The Strange Nuclear Explosion," Spring 1980. Private correspondence with the author.

21. W.K.H. Panofsky, *Arms Control and SALT II*, The Jessie and John Danz Lectures (Seattle: University of Washington Press, 1979), p. 30.

22. Edward Teller, "Technology: The Imbalance of Power," in *The United States in the 1980's*, eds. Dunignan and Rabushka (Hoover, 1980), pp. 511-12.

23. See Arnold Kramish, "Nuclear Flashes in the Night," *The Washington Quarterly*, vol 3, no. 3, pp. 3-11; "Ad Hoc Panel Report on the September 22 Event," Executive Office of the President, Office of Science and Technology Policy, 15 July 1980; Eliot Marshall, "Navy Lab Concludes the Vela Saw a Bomb," *Science*, vols. 107, 209, 29 August 1980, pp. 996-97; Guy E. Barasch, "Light Flashes Produced by An Atmospheric Nuclear Explosion," LASL-79-84 Mini-Review, November 1979; S.T. Cohen, "La Bombe—A Nuclear Detective Story," *The New Republic*, 17 January 1981, pp. 13-14.

24. George B. Kistiakowsky, *A Scientist at the White House* (Cambridge: Harvard University Press, 1976), describes the "Latter holes." See also Bruce Bolt, *Nuclear Explosions and Earthquakes—The Parted Veil* (Berkeley: University of California Press, 1976), chap. 8; and A.L. Latter, "A Method for Concealing Underground Nuclear Explosions," *Journal of Geophysical Research*, vol. 66, 1961, p. 943.

25. I.D. Morokhov, ed., "Experimental Contained Explosions in a Salt Mass," in *Nuclear Explosions for Peaceful Purposes*, trans. R. Addis (Moscow: Atomizdat, 1970), UCRL-Trans-10517, AEC Division of Technical Information. See also Milo D. Nordyke, "A Review of Soviet Data on the Peaceful Uses of Nuclear Explosions," UCRL-51414, rev. 1, 1 April 1974.

26. See W. Stratton, D. Stillman, S. Barr, and H. Agnew, "Are Portions of the Urals Really Contaminated?" *Science* 206 (26 October 1979). The analysts suggest that careless preparations for Soviet atmospheric tests at Novaya Zemlya could account for reported radioactive contamination in the Soviet Union such as described by Zhores Medvedev in his book *Nuclear Disaster in the Urals* (1978).

27. US, Congress, House, Armed Services Committee, HASC 96-6, p. 215.

28. "Report on CTB Negotiations," *Department of State Bulletin*, vol 80, no. 2044, November 1980, pp. 47-48.

V. NUCLEAR EXPLOSIVE TECHNOLOGY

An examination of the objectives for banning nuclear testing "in all environments," and all nuclear explosions "whatever their claimed justification," discloses the claim that a ban would "freeze" the growth of knowledge and understanding of nuclear explosive technology. The ban would thereby serve to "cap," significantly restrain, or "slacken" the US/USSR "nuclear competition."

The objective of banning nuclear explosions is based on technical judgments first formed in the 1950s. It was subsequently reinforced when the Limited Test Ban Treaty (LTBT) was negotiated just after the unceremonious rupturing of a nuclear test moratorium by the Soviet high atmospheric test series of 1961-62.*

Negotiation of the Threshold Test Ban Treaty (TTBT) and the Peaceful Nuclear Explosions Treaty (PNET), unaffected by ICF-related technical developments, took place in the context of the familiar objective of the 1950s and 1960s to prohibit nuclear testing. Our negotiators believed that banning the detonation of weaponized designs and new design concepts would curtail any advancement of nuclear explosive technology, and that the detonations to be banned would of necessity have to be on the order of tens or hundreds of kilotons of yield to be "militarily significant."

Since the 1960s, emphasis in nuclear weapons design has been on reducing yields, sizes, and weights—of technical refinement and sophistication rather than simply escalating explosive yield. The total yield of the US nuclear weapons stockpile has thus been declining for many years.

Five questions of particular importance are pertinent to the issue of nuclear explosive technology: (1) Is nuclear explosive technology a "mature" technology? (2) What potentials for weapons design or development would be forgone by a complete cessation of US testing?¹ (3) What is the significance of inertial confinement fusion (ICF) technology in relation to a test ban? (4) Is it possible to maintain a technically qualified cadre of nuclear weapons scientists during a

*That series is the one which included detonation by the Soviets of a device yielding almost sixty megatons.

test-ban regime? (5) How valid is the idea of technological banishment in arms control and disarmament agreements?

MATURITY OF NUCLEAR EXPLOSIVE TECHNOLOGY

Is nuclear explosive technology mature? Expert opinion is clearly divided along the lines of test-ban preference. Many who advocate a CTB have long claimed that our nuclear explosive technology is mature; therefore, in agreeing to a test ban we would be relinquishing nothing as no important new developments can be expected. But if no important breakthroughs are in prospect, advocates can also claim that a CTB is needed to stop qualitative advancements and curb the "arms race."

One of the most commonly mentioned areas for further improvement in nuclear weapons is that of safety, security, and reliability. In fact, officials in the US nuclear weapons complex feel it is important not only to bring the latest technology to bear in producing new weapons, but also to insure that the newest techniques for maintaining safety and reliability are applied to older weapons as national policy drives us toward an older and older stockpile due to extended retention of some weapons.²

One of the most important new techniques for improving the safety of nuclear weapons is the use of insensitive high explosives (IHE) in their construction, and York concedes that will require continued testing:

*The substitution of IHE components, however, is still in the relatively early stages of development; more tests (as of late 1978) would be needed before the United States could fully exploit this means of increasing both weapons safety and weapons security. The properties and behavior [of] IHEs, compared with those of explosives now used in nuclear weapons, differ to a degree that makes it impossible simply to substitute the one for the other. Certain design modifications are necessary, and the design experts insist that these new designs must be tested before they can be certified.*³

Nuclear scientists active in the weapons program believe important new developments could usefully be pursued in an effort to impart greater safety, security, and reliability to our nuclear weapons stockpile and to new designs (even though continued testing to

achieve these ends has on occasion been derided as of minimal consequence). In a society now demanding from the nuclear power industry nearly perfect guarantees of safety, it is contradictory that some believe that forgoing improved security and reliability for nuclear explosive weapons can promote "stability and arms control"!

It is extremely important to point out that the TTBT has accelerated the trend, begun with Nixon-era budget cuts, of driving our laboratories and test programs away from technology-advancing theoretical design and R&D shots. The pressures placed upon the testing program, first to comply with the TTBT by 31 March 1976, and then to prepare for imposition of a CTB under the Carter administration, have resulted in placing almost all the emphasis in our underground test program on "Phase III" testing, and in almost completely eliminating Phase I and Phase II R&D or stockpile confidence tests.⁴ This trend in the testing program has been described in testimony to the Congress by the Department of Energy and the nuclear laboratory directors, and documented in a study by Brigadier General Albion Knight, USA-Retired, when he was a professional staff member of the Joint Committee on Atomic Energy (JCAE).⁵ The continued accretion of limits on US testing, a process intensified by years of budget cuts, is becoming a self-fulfilling prophecy about the lack of need to test! When the nuclear laboratories are told year after year to emphasize practical applications of tested designs, and to cut back all tests—including theoretical design proof-tests—it is only natural that the testing record would tend to show the technology is "mature," as only applications of known designs to specific systems are being tested!

One of the most important limitations on the testing program is paragraph 2, Article 1 of the TTBT: "Each Party shall limit the number of its underground nuclear weapon tests to a minimum." Major General J. K. Bratton, US Army, Director of Military Applications, Energy Research and Development Administration (ERDA), was questioned by House Armed Services Committee members in early 1977 about test constraints:

There are two treaties under which we are operating now. . . . One is the Limited Test Ban Treaty, which went into effect in 1963. Its principal effect is to require that we test underground. . . . We have the Threshold Test Ban Treaty, which for practical purposes as far as our program is concerned became effective on 31 March 1976.

The principal effects of that treaty are to prevent us from having any nuclear tests, even underground at Nevada, which exceed a design yield of 150 kilotons and to require us to conduct only the minimum numbers of tests considered by the Administrator of ERDA and the Secretary of Defense as the minimum essential to have a viable and ongoing program. We are, of course, adhering to these points even though ... the treaty has not yet been ratified by the Congress.⁶

LOST TECHNICAL ACHIEVEMENTS

What technical possibilities would the United States forgo under a "complete" ban on testing? This question cannot be answered completely in open, unclassified discussion.

In congressional testimony bearing many marks of deletion for security, a few specific new possibilities are identified, such as reduced residual radiation (RRR) weapons, and a variety of safety and security upgrades. Applying the technology of insensitive high explosives (IHE) to nuclear weapons, as already noted, is by no means complete.

Insertable nuclear component (INC) weapons are another technological possibility the United States would have to relinquish in a CTB. In FY 1978, the Departments of Navy and Energy completed a conceptual and feasibility study of a nuclear armed version of the Harpoon antiship missile, taking into account both standard nuclear designs as well as INC designs. Major General Joseph Bratton, US Army, of the Division of Military Applications, Department of Energy, (DOE), testified to the Senate Armed Services Committee in 1978 about the INC concept, and its use in warheads for a tactical system such as Harpoon. Weapons with insertable nuclear components could save valuable storage space on naval ships, submarines, and aircraft that can be armed with the Harpoon, and new weapons of this type could also provide enhanced operational safety compared to existing tactical nuclear weapons.

Cecil I. Hudson, Jr., and Peter H. Haas, in *Beyond Nuclear Deterrence: New Aims, New Arms*, note that potential US tactical nuclear modernization programs include earth-penetrators, enhanced radiation warheads, minimum residual radiation weapons, and "reduced yield" warheads which are increasingly possible as greater accuracy of delivery becomes available.

In their discussion of "low-yield" warheads, Hudson and Haas point out:

Precision-guidance developments permit the use of smaller yields to achieve desired military effects. . . . Recent discussion of the possibility of replacing or renewing some of the current theatre nuclear weapons stockpile with very low yield accurately delivered weapons has included nuclear weapons with yields of tens of tons to perhaps a few hundred tons.⁷

The analysts do not believe, on balance, that subkiloton yields are as attractive as improved conventional munitions delivered with the same accuracy, but their objection is mainly to the inefficient use of special (fissionable) nuclear material (SNM) that the design of very low yield fission weapons entails. A change in the outlook for SNM availability through improved enrichment and reprocessing technologies, as well as continued progress in pure-fusion explosive technology, could therefore change assessments of the desirability of very low yield tactical nuclear warheads.

Under a CTB the United States would be unilaterally depriving itself of important military advantages through evolving improved tactical nuclear weapons, while the nuclear technology of other nations *could run free beneath our seismic monitoring threshold*. Thoughtful consideration of the technology trend in nuclear explosive design, linked to the growing potential of precision guidance for tactical weapons, reveals that great possibilities exist for combining military force improvements with greatly reduced fallout or collateral damage, and improved nuclear operational features such as safety and security equipment of the latest design.

Another important possibility for increased application of our nuclear explosive technology would be use of nuclear explosive devices as drivers for magneto-cumulative generators (MCGs.) These devices deliver very high pulses of electrical power through compression of a magnetic flux field. The fundamental technique, using high explosives to implode magnetic fields, is known and has significant potential.⁸ Driving MCGs would be a nonweapons application of the nuclear explosive technology, as the magneto-cumulative generators would function only as power sources.

It is extremely important to set a proper *context* for discussion of technical possibilities the United States would relinquish in a CTB regime. We should consider only what we know we would forgo, be-

cause we know how we would enforce the CTB—honestly and totally, but we do not know how it would be enforced elsewhere. All the monitoring means now being discussed, if implemented, would not be capable of detecting and identifying the nuclear technological developments we can anticipate in the future. Yet, too frequently, discussions of what we would lose in a CTB begin with the assumption that we "plan" to negotiate "adequate" monitoring capabilities. Based upon that assumption, many then proceed to argue for a benefit known as the "symmetrical" effects of a CTB. The reality is there is no prospect we will be able to tell whether a "CTB" is in fact having "symmetrical" effect, which indicates the criticality of the CTB verification issue. An unfounded assumption of "adequate" verification usually is the *enabler* that permits CTB advocates to argue for the alleged benefits of "symmetrical" effects of test-ban restraints.

INERTIAL CONFINEMENT FUSION TECHNOLOGY

What is the significance of inertial confinement fusion (ICF) technology in relation to a test ban? One of the principal arguments for a comprehensive test ban is that it will freeze the technology of nuclear explosives. *Arms Control 1978*, the President's annual report on arms control to Congress, expressed the CTB objective:

Mutual cessation of nuclear testing would essentially freeze nuclear-weapon technology at current levels and, by constraining the modernization of Soviet nuclear forces, significantly contribute to US security.⁹

Note that this basic CTB objective relies upon the specious argument of "symmetrical effect" for the ban to have an impact on Soviet programs.

It is in the context of a supposed technological "freeze" that this discussion of the technology of inertial confinement fusion and its relevance to the question of limiting or banning nuclear tests proceeds. Inertial confinement fusion is a growing, exciting, and challenging technology. The FY 1981 budget request for ICF was \$202 million. Justification for ICF before congressional committees has consistently been that it provides both military benefits and a possible course to commercial fusion power for peaceful purposes.

Inertial confinement fusion has evolved from an obscure aspect of controlled thermonuclear reaction (CTR) research to a noteworthy

program within the budget of the Department of Energy Division of Military Applications. Several different approaches to accomplishing ICF are being undertaken. Some believe that ICF is a feasible approach to CTR, and thereby fusion power for peaceful energy application. More research is needed before basic decisions on fusion reactor engineering design approaches can be made. The cessation of all nuclear yield testing of nuclear explosive devices by the United States could possibly be interpreted to include ICF, thereby stopping the growth of ICF technology in this country.

A key fact about ICF which links it to the issue of limiting or banning nuclear explosions is that an ICF reaction is essentially a "bomb in a bottle." Expert testimony on this point is abundant in the open literature. Dr. Herbert F. York, former head of the US delegation to the CTB negotiations with the Soviet Union and United Kingdom, states the following in *Arms Control: Readings from Scientific American*:

The extreme violence of the reactions in hydrogen bombs makes it impossible to convert their huge energy output directly to useful electric power. . . . However, two general methods have been suggested for producing thermonuclear energy in a less violent manner.

One is [magnetic fusion energy]. . . . The other method is to produce a semicontinuous series of discrete micro-explosions of very tiny hydrogen bombs initiated by intense bursts of laser light.¹⁹

In his June 1979 monograph, *The Comprehensive Nuclear Test Ban*, Dr. York discusses ICF under the heading "Other Technical Issues—Definition of Nuclear Testing." It is a format which implies that the matter of ICF is a technicality, rather than a question which goes to the very heart of the pro-CTB arguments of test-ban advocates. In describing the "current" ICF development program—with no reference to the voluminous information in congressional testimony about the specific goals of this program—York observes:

The capsule should implode and its contents should reach the high-density and high-temperature conditions necessary for a thermonuclear explosion of relatively tiny proportions. If the capsule contains some tens of milligrams, the resulting explosion could be equivalent to that of a ton of TNT. Is this a nuclear explosion? Certainly. Is it or could it be considered a nuclear weapon? Not in its present form, which typically involves

very complex and exceedingly heavy ancillary equipment for generating the driving beams. For this reason, a consensus exists that the possible future overlap between these devices and nuclear weapons should be ignored for purposes of the current CTB.¹¹

Dr. York's effort to deal inertial confinement fusion (ICF) out of the CTB issue raises the question of who are the members of the "consensus," and ignores a great deal of testimony before Congress strongly contradicting the notion that ICF has benign implications for nuclear explosive technology and nuclear weapons development. In arguing that ICF is not a "weapon," and in failing to comment upon the well-documented (see below) military benefits being derived from this "peaceful" technology, York is advancing a Soviet-style interpretation of the basic scope of the CTB prohibition—that it is a ban of test explosions of nuclear *weapons* only. Although Chief of the American CTB delegation, York chooses not to mention the historic US position that *any* nuclear explosion provides inherent military benefits—a position established well before the important growth of ICF technology that has taken place in recent years, but vindicated and substantiated by the known facts about ICF.

Major General Edward B. Giller, US Air Force-Retired, the Joint Chiefs of Staff representative on the US delegation to the CTB negotiations, indicated to *Science* magazine writer Robert Gillette in 1975 that he felt there was a link between inertial confinement fusion and a comprehensive test ban:

"People go around town saying this is an energy program, but that's something that came along only after energy research got popular," Major General Edward B. Giller, the chief of national security in the Energy Research and Development Administration (ERDA) said in a recent conversation. "What we're doing now, developing basic laser technology, is equally applicable to military and civilian aspects. But really, this is a military program and it always has been," Giller continued.

"It would be a very useful thing to have in a comprehensive test ban. . . . It would keep the weapons labs busy for 5 to 10 years anyway."¹²

Inertial confinement fusion is clearly deemed relevant to the question of proliferation; arms control impact statements (ACIS) on the concept have been rendered to Congress by the executive branch since 1979. Because the whole issue of proliferation turns on

nuclear design and development capability, it may not be possible to argue convincingly that ICF is not relevant to nuclear testing, but is relevant to nuclear proliferation.

The ICF arms control impact statement for FY 1980, in describing the concept, does not mention specifically that a thermonuclear explosion is involved. However, the introduction to the impact statement points out that the United States, when questioned in 1975 in connection with the NPT Review Conference, declared that "certain types" of ICF energy sources "do not constitute nuclear explosive devices within the meaning of the NPT and IAEA safeguards agreements." A footnote in the impact statement specifies the "certain types" exempted:

Identified as "involving nuclear reactions initiated in millimeter-sized pellets of fissionable and/or fusionable material by lasers or by energetic beams of particles in which the energy releases, while extremely rapid, are designed to be, and will be, non-destructively contained within a suitable vessel."¹³

Whether the current or future state of ICF technology will utilize "millimeter-sized pellets," and whether energy release is "non-destructively contained," are of course irrelevant to the matter of "freezing" a technology. However, the United States apparently continued its argument that ICF should be exempt from NPT safeguards throughout the 1980 review conference.

In discussing the status of the US ICF program, the FY 1980 arms control impact statement fails to note that all of the funding is through the Military Application of Nuclear Energy Subcommittees, over which the House and Senate Armed Services Committees have cognizance, and that organizationally the ICF work at Los Alamos and management at DOE Headquarters is subordinated to officials responsible for defense programs. Regarding "possible applications" of ICF, only a brief sentence about reducing energy shortages is included in the impact statement; and the document declares "there are no stated military requirements" for ICF. This may be a technicality in that the Department of Defense states requirements for nuclear weapons to the Department of Energy, but would not necessarily stipulate that ICF be used, or contribute, to fulfilling them.

The entire FY 1980 ICF arms control impact statement is riddled with deletions reflecting security-related information. However, in the

final paragraph containing the "Overall Arms Control Assessment," we learn that "the possible applications of ICF to the nuclear weapons program are primarily indirect." But repeated statements to the Congress by DOE officials leave little doubt as to the direct benefits of ICF for our nation's nuclear weapons effort.

The following pages will draw upon official sources in order to provide a basis for understanding that ICF is highly important to the whole issue of nuclear explosive technology in the context of a CTB.

Basic approaches to understanding the secret of fusion include theoretical physics (assisted by computer calculations), computer-based analyses drawing upon combinations of theoretical and empirical inputs, magnetic fusion energy (MFE) technology,¹⁴ underground nuclear tests to collect empirical data, and the newer field of research referred to generically as ICF. The ICF research projects the government has underway utilize various techniques for "driving" the fusion reaction: lasers, charged and neutral particle beams, and heavy ion beams. These drivers are analogous to the fission "trigger" of the fusion reaction in thermonuclear weapons, but they are being developed to permit the achievement of fusion "burn" in a controlled and contained manner. The problem in designing these experiments is in determining the most effective approaches to mastering the extremely complex physics involved.

Several source documents provide good introductory information on ICF. One such source is Dr. Edward Teller's chapter on "Controlled Fusion" in his book *Energy From Heaven and Earth*.

In describing the inability of physicists to move rapidly from explosive energy release via fusion, first accomplished in 1952, to controlled thermonuclear reactions, Teller observes that "explosive release of fusion energy has practically nothing in common with controlled fusion except the occurrence of certain nuclear reactions." This is true in that the design of a fusion power reactor would be quite unlike a fusion bomb. On the other hand, the predictability of the benefits and applicability for bomb-building of the new basic knowledge to be generated as ICF research continues is uncertain. One major complicating factor is the simultaneous development of the technology of high-energy laser and particle beam drivers along with the fusion targets and ancillary equipment, such as transmission lines and mirror systems. It would seem to be a mistake to sign a treaty with the Russians, who are also heavily involved in ICF,

declaring that "all" nuclear explosions had been banned while ICF technology is in ferment. The first net energy gain* from US laser fusion tests is not anticipated until 1983 or after—and achievement of net energy gain will represent the take-off point for ICF technology!

In discussing laser fusion, Dr. Teller points out that the effort is to concentrate energy to "produce electric fields much stronger than that holding electrons in orbit within the atom." Disruption of the atom of thermonuclear fuel causes instantaneous evaporation and implosion to a high density of mass remaining. The theory of how the reaction will proceed in a compressed nucleus

seems to be correct. If you have one thousandth the radius you have one billionth the volume, but at a thousand times the density. Therefore, we have 10^{-6} or one-millionth of the mass, and the energy released will also be one-millionth. In both cases, the reaction will go more or less to completion. So instead of producing energy of a megaton, you produce only one ton TNT equivalent.¹⁵

Although many would dismiss such a low yield as insignificant or "not a weapon," we should be circumspect in considering the implications of inertial confinement fusion for negotiating a "comprehensive ban" on "nuclear explosions in all environments for whatever their claimed justification." While the laser fusion and other ICF reactions are referred to as "microexplosions," the size of the explosion is a function of the kind of fuel used, the amount used, the ingredients and design of the target pellet, the energy coupled to the target from the driver, and other technical factors. Scientists believe that controlled fusion reactions to produce peaceful nuclear power will require that the actual physics of the fusion "burn" of basic elements, such as the isotopes deuterium and tritium, be explicitly understood, and experimentation is directed toward that end. It is an iterative process whereby empirical results of "shots" of pellets by lasers or beam devices can be used to update computer codes that simulate the propagation of fusion reactions through the fuel. As such knowledge progresses, we will inevitably understand more about explosive weapons based upon fusion reactions.

The question arises whether ICF experimentation could substitute for nuclear tests, and if so in what respects.

*Net energy gain means that more energy would be obtained from the "burn" of the fusible material than had been input from the driver.

In 1979, the Department of Energy addressed the issue for the record:

Inertial fusion is severely limited, however, in many aspects. It cannot replace weapons proof testing where the passage of time has decreased confidence in weapons reliability. It contributes only indirectly to stockpile maintenance by retaining some weapons-physics skills.

In summation then, inertial-fusion weapons contributions under a CTB are quite limited, but these contributions are the closest approaches to weapons technology that will be permitted to some critical areas of physics and materials understanding.¹⁶

The linkage to CTB, however, is not just whether ICF could replace underground testing, but whether ICF reactions—being thermonuclear explosions—provide any inherent military benefits.

The application and applicability of ICF to "military" purposes is made evident in voluminous testimony to Congress in recent years. Because some consider this question controversial in the context of a CTB, and also because published testimony on ICF before the House and Senate Armed Services Committees contains deletions, it is important to stress that expert statements about military benefits of ICF are sufficiently detailed to make clear their appropriate context. Experts who have testified on military benefits of ICF include Dr. R.B. Perkins, Manager of Laser Fusion Programs at Los Alamos, Dr. E.H. Beckner, Director of Physical Research at Sandia Laboratories, and all the top managers of the inertial fusion program at the Energy Research and Development Administration and the Department of Energy/Division of Military Applications since 1977.

Not only does ICF have significant application to problems of nuclear weapons design and development which are usually solved through reliance, at least in part, on underground testing at the Nevada Test Site; but Dr. John Emmett, Associate Director for Lasers of Livermore Laboratory, suggests that, for some purposes, ICF is, or will be, *better* than underground testing:

With the NOVA system we will be able to achieve 200 million atmospheres pressure in the laboratory, in almost any material in the periodic table. Our equation-of-state people are just extremely enthusiastic about having that capability.¹⁷

Testimony by DOE scientists and top managers consistently emphasizes the military importance of ICF research, especially the vital role it will play in retaining first-rate scientists in the weapons laboratories during a CTB regime (however defined or prolonged). Published testimony also sheds light on some of the variables in ICF. This consideration is important because of the argument that ICF is "too small" to be a weapon. But as research progresses, and new knowledge is uncovered, the size of the yield of pellet fusion explosions can be expected to increase.

For example, although there are customary references in the testimony to the "microballoons" used as ICF targets, there are also references to larger targets, such as the size of a marble, along with remarks about reducing constraints on target size through various improvements in the drivers.¹⁸

One of the most thorough accounts of the linkage between ICF technology and the nuclear weapons test and development program was provided in testimony before the Procurement and Military Nuclear Systems Subcommittee of the House Armed Services Committee in early 1979. The statement was provided by Dr. John Emmett, Associate Director for Lasers of the Lawrence Livermore Laboratory.

Dr. Emmett discusses military applications of ICF in two situations, with and without a CTB. In the case of no CTB, the military applications of ICF would include basic experiments that would contribute to the physics data base, for example, understanding the properties of materials under extreme high pressure conditions like those existing in weapons. Non-CTB applications would also include development of mutually supportive computer programs because "the computer codes that calculate laser fusion problems and those of weapons problems have great similarities and improvements in either area are quite supportive." Finally, ICF research and techniques would allow for certain nuclear weapon radiation effects simulation on reentry vehicles, missiles, and satellites without underground tests, (even if there were no ban on such tests).

The 1978 Institutional Plan—Long Range Projections (1978–1984) of the Los Alamos Laboratory describes ICF applications and advanced technology as being "directed toward main contributions in weapons technology (in the mid-to-late-80's)." Two paragraphs describe the weapons technology effort in detail:

Our baseline [ICF Weapons Technology] plan through FY-84 calls for providing continued support of experiments directed solely to weapons applications. . . . The TBS [Two-Beam Systems] will be devoted essentially full time to these experiments beginning in FY-81 and Helios will be available for most of its operating time late in FY-83. It is anticipated that initial weapons-related experiments may be performed on Antares in FY-84. The increased power available from these systems will be needed to extend the range of current experiments on equation-of-state, shock micro-structure, opacity and fireball simulation measurements, and for the study of implosion dynamics and weapons effects.

The baseline funding projections do not take into account an accelerated program in the case of a CTB. Funding requirements in this case would be substantially greater (approximately double).¹⁹

Thus, in examining the question of inertial confinement fusion (ICF) in its relationship to CTB, it is clear the two issues are entangled.

The comprehensive test ban is advertised to be a "comprehensive" prohibition of *all* nuclear explosions "whatever their claimed justification," in order to "freeze" progress in the technology of nuclear explosions. But ICF is a nuclear explosion. However, ICF is by some "consensus" ignored in CTB, and, in addition, ICF is not claimed as a substitute for actual testing by our nuclear test authorities. Yet, the same authorities make it clear that ICF experimentation will permit maintenance and even improvement in nuclear explosive technology by facilitating retention of a trained cadre of skilled weapons designers, by providing (in some respects) better diagnostics, and by revealing progressively more profound data on the fundamental properties of matter and the fusion-burn process.

The yields involved now, and in the future of ICF, are such that they do not permit detection by seismic means. Low yield weapons designs could, it would seem, be easily tested in containment under the guise of ICF activity. Even if adequate tests of designs were not possible, ICF could prepare a CTB signatory nation for a significant "break out" from test-ban constraints, such as the Soviets demonstrated when they moved out of the 1958-61 nuclear test moratorium with a rapid series of significant and well-conceived tests. While preparation for break-out is a CTB risk in any case, the kind of progress forecast for ICF in the 1980s and its proliferation potential exacerbates the breakout risk.

To summarize, there are sound technical reasons to conclude that ICF is relevant to the policy issues being addressed in the CTB negotiations:

—*Definition of a nuclear explosion.* An ICF reaction is a thermonuclear explosion. It is insufficient to say that ICF reactions are too small to hurt anyone, that they could not be "weaponized," or that they are nondestructively contained. Since ICF involves thermonuclear explosions, it should be explicitly addressed in any international agreement regulating or banning such explosions by agreed upon language contained in the basic document.

—*Inherent military benefits.* Clearly ICF is providing the United States with "military benefits." The House Armed Services Committee, Procurement and Military Nuclear Systems Subcommittee, which oversees funding for ICF, has been told that the bulk of the benefit from ICF is military. Whether the "benefit" is directly in the area of providing information on how to design an explosive device, or in other areas, is not relevant to the question involved in the test-ban negotiations, where the United States takes the position that any nuclear explosion provides "inherent military benefits."

—*Proliferation aspect.* Discussed in section 7.

—*"Capping" growth of nuclear explosive technology.* It would be deceptive to conclude a "CTB" treaty that did not deal with ICF and claim the agreement would "cap the growth of nuclear explosive technology." In fact, ICF is one of the most sophisticated fields of nuclear research, and could never be "banned" by a treaty reliant upon seismic monitoring techniques.

TRAINING NUCLEAR WEAPONS SCIENTISTS

Is it possible to maintain a sufficient cadre of trained scientists under a CTB? This problem, which could be partially alleviated by ICF research, is also linked to a larger philosophical and policy issue of using a CTB to proscribe an entire area of scientific inquiry. Dr. M.R. Gustavson of Livermore Laboratory has addressed this matter specifically in a commentary entitled "CTB: A Precedent in Restricting Inquiry?" Dr. Gustavson sees the "precedent-setting quali-

ty" of a CTB agreement as perhaps the most important issue of all, because as a precedent the CTB would have implications and possible effects beyond the scientific area of nuclear explosive technology.

Dr. Gustavson explains that the "precedent" involved is "the foreclosing by law of particular lines of technical inquiry." The precedent issue is of fundamental importance;

While some of the arguments for and against a CTB clearly are two-sided, it seems obvious that a ban on testing would make it impossible to maintain a cadre of experienced and knowledgeable individuals in this highly specialized field. That may well be the key point, for, *with a CTB where would experienced and knowledgeable personnel come from and how will their expertise be validated?*

Indeed, advocates of a CTB seem unanimous in seeing as one of its principal merits this hobbling effect of no testing on innovation. Some CTB advocates hope, and many opponents fear, that not only will there be the hobbling effect on innovation, but that *it will not even prove feasible to maintain the existing competence indefinitely.*²⁰

Deciding the future of the existing nuclear weapons establishment under a CTB "regime" became a critical issue for those responsible by appointment and law for our national laboratories and their nuclear weapons design and development capabilities, who were confronted with nearly overwhelming political pressures to accede to a so-called "comprehensive" test ban during the Carter round.

One lesson learned from the 1958-61 uninspected moratorium on nuclear testing was that the Soviet infrastructure of people and facilities devoted to nuclear weapons design and development remained in place, and was prepared for the end of the moratorium. Cohen and Van Cleave argue further that the Soviets must have conducted lower yield tests during the moratorium to prepare for the kinds of tests they conducted when they broke out:

Clearly, the Soviets used the period of the moratorium to prepare clandestinely and methodically the extensive series of tests with which they broke the moratorium. But what President Kennedy may not have realized was that the Russians may have been doing more than just planning: there is a dis-

tinct possibility that the Soviets were actually conducting secret underground tests during this period of the presumed moratorium on testing. In view of the phenomenal progress they were able to make in the spasm of atmospheric testing they conducted during the autumn of 1961, it can be argued that they almost had to have performed experiments at lower nuclear explosive levels to check out the basic design of their hydrogen warheads prior to full-scale testing.²¹

Today, an analogous situation exists. No assurance being sought, or that (realistically) could be obtained, could prevent the Soviet Union from using the period of the treaty to prepare for tests to be set off after the agreement lapses.* The Los Alamos and Livermore Laboratory directors have made it clear they consider it of vital importance that a highly qualified cadre of professionals be maintained active in our laboratories. The laboratory directors perceive perhaps the biggest threat of a CTB, including one of "fixed duration", to be in the personnel area. The threat is not only that people will leave the laboratories, but also that the people remaining will be less than optimally qualified because of the limited or nonexistent actual test validation of their work. Indeed, this kind of threat is not confined to a test-ban or moratorium situation, but exists to a degree today, because numbers of tests are limited, and all the indications, for planning by career-oriented people, are that US testing will cease as soon as the political climate permits.²²

In his testimony before Congress in early 1978, Dr. Harold Agnew, then Los Alamos Director, placed heavy emphasis on the people and facilities issues. In that context he emphasized Soviet preparations and referred to disclosure by *Aviation Week* in May 1977 of a Soviet facility at Semipalatinsk which "will allow the Soviets to repetitively test nuclear devices up to 1/4 kiloton [250 tons] in a laboratory environment. Such tests would be fully contained and undetectable offsite."²³ According to *Aviation Week*, at this estimated \$3 billion facility, containment would be accomplished by detonating nuclear devices inside eighteen-meter diameter steel spheres emplaced in granite. Also referring to the *Aviation Week* disclosure, Dr. Agnew testified:

* Indeed, they would be stimulated to do so if the President declared that the United States would resume full-scale testing at the end of the "fixed duration" treaty. See section 6.

I would hope some of you have access to the intelligence community so that you can hear firsthand about the facilities which [the Soviets] have been building up, having started at the time of the last moratorium. Some people in this country believed the Soviets clearly were getting ready to do an extensive nuclear program even under a moratorium. The facility described is the famous one reported in *Aviation Week*; they do not underestimate the magnitude of the facility. It is very large and expensive, and to us, as we look at it, it would seem to lend itself well to conducting a vigorous test program even under a complete test ban.²⁴

Dr. Agnew's reference to the reported Soviet facility came in his testimony about the problem faced by the US laboratories in retaining needed skilled people and facilities under even a "fixed duration" CTB. It is important to view the "atrophy" issue in the context of a test-ban regime wherein there is not only the question of a decline in our capabilities, but also grave uncertainty about the actions of other parties!

BANNING TECHNOLOGY THROUGH ARMS AGREEMENTS

How valid is the idea of technological banishment in arms control and disarmament agreements?

As mentioned before, a great part of the emphasis on CTB is due to desires to banish nuclear explosive technology, and to eliminate our nation's capability for the technological development of nuclear weapons. Since the United States has maintained, historically, a technological superiority over other countries, this is a major concession of principle that must be seriously considered because the same antitechnology bias is present in other arms control negotiations and agreements.

Our official strategy is not to renounce new technology. Our capabilities for technical growth and improvement are crucial factors in defense planning. While the United States acknowledges "essential equivalence" of strategic nuclear force capabilities in the SALT II regime, we have never abandoned but continue to maintain an objective, in the technological realm, of superiority, not equivalence. The 1979 DOD Posture Statement asserts:

The Science and Technology Program is that portion of the DOD's RDT&E Program that provides the foundation for maintaining US *technological superiority*.

Dr. William J. Perry, former Under Secretary of Defense for Research and Engineering, stressed technological leadership. He told Congress:

We must put a greater emphasis on our strongest advantage over the Soviet Union—our technology. Chairman Brezhnev has put it aptly. . . . He argues that scientific and technological progress will have "decisive significance" in the competition with the Western World. I agree with him, and I believe that we can win that competition. . . . We must determine which specific technologies can give us the greatest leverage in our force modernization.²⁵

Would Dr. Perry include nuclear explosive technology in a list of "specific" technologies that would give us "leverage in strategic force modernization"?

Because the US nuclear weapons test and production program is not funded out of the DOD budget, cynics could argue that the DOD policy statements accompanying the DOD budget submission do not address the US nuclear testing program, and, therefore, DOD remarks about technological superiority do not apply to nuclear weapons. But US-USSR nuclear technologies are compared and judged to be about equal in the FY 1981 Defense Report. There is *pro-test ban testimony on record before the Congress asserting that an advantage of a CTB that would "freeze" nuclear explosive technology is that it would maintain a present alleged superiority in nuclear technology!*²⁶

The DOD submission to Congress on the FY 1981 Program for Research, Development, and Acquisition lists "RD&A Program Emphasis for the 1980s." (Note that this title is not, "for 1981," but "for the 1980s"). Dr. Perry asserts:

The 1980s threaten to be a period of growing international tension and danger for the United States if the Soviet Union continues its military buildup and its aggressive attempts to expand political influence. . . . Five specific areas of emphasis should be noted: *we must maintain unambiguous nuclear deterrence.*²⁷

One cannot fail to be struck by the contrast between a declaratory policy of "maintain unambiguous nuclear deterrence" through the 1980s—with resources of \$8 billion sought for FY 1981 alone for strategic forces programs—and a negotiations policy that calls for choking off nuclear explosive technology needed to maintain our position in the area of nuclear weapons, as well as fix problems should they arise in the nuclear stockpile. See section 6.

The principle of aggressive US pursuit and maintenance of nuclear weapons technological superiority also appears to be at risk in the negotiations we have been conducting with the Soviet Union on "new mass destruction weapons [MDW]."

The concept of MDW (or "New" MDW) is unsuitable for meaningful arms control negotiations. The phrase is a catch-all, lending itself to polemics, propaganda, and abuse. The US systems mentioned by the Soviets as "New MDW" include B-1, Trident, MX, Space Shuttle, "neutron bomb," particle beam weapons, and depleted uranium slugs for the XM-1 tank and the A-10 aircraft's 30mm guns. No one on the US side has argued with any degree of credibility that the concept of MDW can advance the "cause" of arms control. The destructive effects of any weapon are a function of the nature and scope of its employment, and none is inevitably dedicated to "mass destruction."

The Soviet campaign on New MDW began in June 1975, with a Brezhnev speech containing the following paragraph:

The level of science and technology today is such that there is a serious danger of creating weapons even more terrible than nuclear ones. The good sense and conscience of mankind dictate the necessity of putting up an insurmountable barrier to the emergence of such weapons.²⁸

The Soviet initiative on new mass destruction weapons appears to be unambiguously directed against US technology advancement not only in nuclear warheads but also in applications of particle beam accelerators. This is another example of Soviet willingness to use the forum of international negotiations to pillory a new US development as an abuse of science and technology, comparable to their unremitting campaign against enhanced radiation weapons, and theater nuclear weapons modernization as a whole. In 1979 the Soviets took the unusual step of introducing into the Committee on Disarmament a working document that names the United States specifically as a

country engaging in development of new mass destruction weapons. The following are pertinent excerpts from the Soviet document entitled "Negotiations on the Question of the Prohibition of New Types of Weapons of Mass Destruction and New Systems of Such Weapons":

Several countries are carrying out intensive work on the development of fundamentally new methods of accelerating charged particles, and, taken together with the success achieved with regard to the development of superconducting materials, this opens up real possibilities of reducing the size and weight of accelerator systems and the sources of energy used to operate them, and in theory, paves the way in the foreseeable future for the development of powerful accelerator devices—whose weight and dimensions could permit their use as weapons. *Direct confirmation of the possibility of this happening is provided by the programme of work being carried out in the United States with a view to developing weapons using bundles of accelerated charged or neutral particles, as may be seen from published accounts of hearings in the United States Congress and other material that has appeared in the United States press.*²⁹

Note that the foregoing is an official position of the Soviet Government tabled in an international negotiating body—not a TASS release or a translation from a textbook.

The 1979 Arms Control Impact Statement on Directed Energy Programs indicates that, while US negotiators do not agree with the Soviet Union that the DOD particle beam (PB) program constitutes New MDW, they appear to be exempting our program from the Soviet label of New MDW only because of a narrowly construed definition of a PB weapon as a "point weapon." But the impact statement suggests the technology is too immature to allow an accurate characterization of how its applications could be militarized.³⁰

It is important to recognize that the accelerators which would drive PB weapons involve basically the same technology we are using in ICF research. Particularly in the Electron Beam Fusion Accelerator at Sandia, technology has progressed such that it appears the E-beam, neutral beam, and heavy-ion beam drivers may be the most effective for ICF applications. Dr. Yonas of Sandia compares US and USSR work in particle-beam fusion:

The US particle-beam fusion program is proceeding at a pace comparable to the Russian program at the Kurchatov In-

stitute. . . . The effort at the Kurchatov Institute is centered on the development of a \$50-million accelerator called Angara V, which will have an energy output of 100 trillion watts when pellet experiments are scheduled to begin in 1984. The Russians are considering pellets with very high energy gains (greater than 1,000). . . . It is evident that the technology is rapidly evolving for the irradiation of fuel pellets with high-current particle beams powerful enough to produce a significant output of fusion energy.³¹

Dr. Yonas' observation about the Angara V project prompts the question: why is the Soviet Union coming into the international forum of the Committee on Disarmament and urgently raising the question of banning research leading to new mass destruction particle beam accelerator weapons?

In summary, a great deal has been said about the desirability of having a CTB in order to stop the growth in nuclear explosions technology. Since 1975, the Soviet Union has been pursuing a parallel political-diplomatic offensive calling for banning of other technologies—notably particle beam accelerators—which they say will lead to “new mass destruction weapons”; and they have achieved a degree of success in entangling the United States in such negotiations. It would appear that the idea of negotiated bans on lines of technological endeavor and scientific inquiry, inherent in the pro-CTB argument, needs a thorough policy review.

NOTES

1. This question can only be discussed rationally in terms of US losses. The use of mirror-image analysis to assert that Soviet nuclear technology would suffer the same losses or degradations is inadmissible because it cannot be substantiated with facts.

2. This point was heavily stressed by Sandia National Laboratories officials during a February 1980 visit.

3. Herbert F. York and G. Allen Greb, *The Comprehensive Nuclear Test Ban*, Discussion Paper no. 84, California Seminar on Arms Control and

Foreign Policy, Santa Monica, California, June 1979, p. 22. (Emphasis added.)

4. Department of Energy nuclear warhead phases, with representative durations, are:

<i>Phase 1</i> Concept Study 0.5 Year	<i>Phase 2</i> Feasibility Study 1 Year	<i>Phase 3</i> Development Engineering — 4-6 Years —	<i>Phase 4</i> Production
<i>Phase 5</i> First Production — 8 to 25 Years —	<i>Phase 6</i> Quantity Production & Stockpile	<i>Phase 7</i> Retirement Disposal 1-4 Years	

5. Brigadier General Albion W. Knight, USA (Ret.), "The Nuclear Weapons Labs: An Endangered Species," *Air Force Magazine*, August 1977, pp. 36-40. The article recounts the key findings of an investigation conducted by Knight at the request of JCAE Chairman Melvin Price into the matter of the deterioration of the US nuclear weapons research and development capability. As of March 1975: "As a result of decreased laboratory resources, the increased DOD demands for weaponization efforts, and the need to complete weapons testing in yields greater than 150 kilotons before the TTBT was effective, the advanced development effort of the laboratories was essentially abandoned." (Emphasis added.) Knight points out that the Ford administration generally acknowledged the validity of his findings and took action in the FY 1977 ERDA budget. However, he feels that the limited efforts only just begun under Ford, before the Carter administration came in with renewed emphasis on constraining our nuclear program, were insufficient to solve the basic problems uncovered.

6. US, Congress, House, Armed Services Committee, HASC 95-15, p. 205. (Emphasis added.)

7. Cecil I. Hudson, Jr., and Peter H. Haas, "New Technologies: The Prospects," in *Beyond Nuclear Deterrence: New Aims, New Arms*, eds. Johan J. Holst and Uwe Nerlich (New York: Crane Russak, 1978), pp. 104-47.

8. C.M. Fowler, R.S. Caird, and W.B. Garn, "An Introduction to Explosive Magnetic Flux Compression Generators," Los Alamos Scientific Laboratory, LA-5890-MS, March 1975.

9. *Arms Control* 1978, May 1979.

10. *Arms Control, Readings from Scientific American*, with introduction by Herbert F. York (San Francisco: W.H. Freeman and Company, 1973), p. 345.

11. York and Greb, *The Comprehensive Nuclear Test Ban*, p. 41.

12. *Science*, vol. 188, 4 April 1975, pp. 30, 31. The entire article is worth reading. It holds up well after several years.

13. US, Congress, "Inertial Confinement Fusion," *Fiscal Year 1980 Arms Control Impact Statements*, Joint Committee Print, 96th Cong., 1st sess., (Washington, DC: Government Printing Office, 1979), p. 246.

14. Research in magnetic fusion energy (MFE) technology is extremely important, but will not be discussed in any detail in this study. In magnetic fusion, fuel in plasma form is to undergo fusion burn while confined by an elaborately shaped field of magnetic force. The United States pursued secret experiments in MFE in the 1950s, but critical disclosures by Soviet researcher I.V. Kurchatov and the pressures for openness from advocates such as Dr. Edward Teller resulted in a decision in 1958 in connection with the Atoms for Peace Conference in Geneva to declassify all US-MFE research, and so it has remained. Soviet MFE technology advanced in the 1960s, one result being their famous design for an MFE reactor called TOKAMAK. The word, derived from an acronym translated from the Russian alphabet, refers to the donut-shaped magnetic bottle confinement scheme. Researchers in the United States, in particular those at Princeton, have adapted and improved upon the basic TOKAMAK concept, and confidence that MFE techniques will be successfully developed for commercial fusion power in about 20 years appears to be growing. This is now happening only after years of frustration when MFE researchers struggled to overcome the numerous instabilities occurring in the extreme conditions that exist in the realm of fusion reactions. The adapted TOKAMAK design was proposed by former Congressman Mike McCormack for a demonstration fusion reactor for the United States on a crash basis, and the Atomic Industrial Forum has published results of a study that recommend greater effort toward early demonstration of an MFE reactor. Federal funding has also been sought for a proposed "throw-away" TOKAMAK, a less costly device which could also breed fuel for fission power reactors. US/USSR cooperative scientific and technical exchanges in MFE have been ongoing for years, and the 1973 Agreement on Science and Technology Cooperation in the Field of Peaceful Uses of Atomic Energy explicitly lists controlled thermonuclear reactions as an area of cooperation. The Soviets have proposed construction, under that agreement, of an international TOKAMAK reactor that would presumably go beyond the results achieved thus far in independent MFE efforts in the United States, Soviet Union, Japan, and the European community. Although some believe military applications are possible using MFE technology, the research remains unclassified and is being

freely shared with other nations, no government officials have suggested this activity has adverse implications for nonproliferation policy, funding for US MFE research has not been justified before Congress based upon need for military or national security benefits, and MFE research management by the Department of Energy is not carried out by the Division of Military Application.

15. Edward Teller, *Energy from Heaven and Earth* (San Francisco: W.H. Freeman and Company, 1979), p. 214.

16. US, Congress, House, Armed Services Committee, HASC 96-6, "Questions Submitted to the Department of Energy," pp. 406-20.

17. US, Congress, House, Armed Services Committee, HASC 95-15, pp. 352-54.

18. US, Congress, House, Armed Services Committee, HASC 96-6, pp. 354-68. Statement/briefing by Dr. Gerold Yonas, Sandia Laboratories, Albuquerque. Also, p. 296, from Statement of Dr. R.L. Schriever, Acting Director, Office of Inertial Fusion, Department of Energy: "The unique feature of laser fusion is the tiny pellets which are used . . . to contain the fuel that will be used in fusion for reactors. *Such pellets will be more the size of a child's marble, consistent with the larger systems that would be eventually needed.*" (Emphasis added.)

19. "Helios" is an 8-beam, 20-terawatt carbon dioxide laser which has been in operation since 1978 (a terawatt is a trillion watts). "Antares," scheduled for operation in 1983, is a 100 to 200 terawatt multibeam laser system being designed to drive a target to produce breakeven thermonuclear yield. US, Department of Energy, Contract W-7405-Eng. 36, "Institutional Plan—Long Range Projections 1978-1984," October 1978, Los Alamos Scientific Laboratory, University of California, 1978, p. 84.

20. Dr. M.R. Gustavson, "CTB: A Precedent in Restricting Inquiry?" *Air Force*, June 1979, p. 118. (Emphasis added.)

21. S.T. Cohen and W.R. VanCleave, "The Nuclear Test Ban: A Dangerous Anachronism," *National Review*, July 1977, p. 770.

22. Views expressed by nuclear laboratory officials during visits in February 1980.

23. US, Congress, House, Armed Services Committee, HASC 95-58, p. 272.

24. Ibid.

25. US, Department of Defense, *The FY 1979 Department of Defense Program for Research, Development and Acquisition*, 1 February 1978, pp. 1-5.

26. The HASC CTB Panel Report, in reviewing the 1978 hearings and testimony, concludes:

"The key State Department and ACDA argument for the CTB, i.e., that the United States is ahead in weapons technology, appears upon close examination to be a bare assertion. There are no good data available to the US experts on which to base such an assertion. . . . No technical authority or documentation to substantiate these claims was offered."

27. *The FY 1981 Department of Defense Program for Research, Development, and Acquisition*, Statement by Honorable William J. Perry, USDRE, to 96th Cong., 2d sess., 7 February 1980, pp. 1-7.

28. *Documents on Disarmament*, 1975, p. 192.

29. United Nations, Committee on Disarmament, CD/35, 10 July 1979, "Letter dated 10 July 1979 from the Representative of the Union of Soviet Socialist Republics to the Committee on Disarmament," pp. 1, 4.

30. FY 1980 ACIS, "Directed Energy Programs," p. 101.

31. Gerold Yonas, "Fusion Power with Particle Beams," *Scientific American*, November 1978, p. 53.

VI. NUCLEAR STOCKPILE CONFIDENCE

The threat that a CTB would seriously undermine US confidence in the workability of the nuclear weapons stockpile has become a matter of growing urgency in recent years. This is only natural because CTB has been an issue since the 1950s, and many weapons have been designed, developed, tested, manufactured, stockpiled and have aged in the stockpile during the intervening years.

RELIABILITY: A CONTROVERSIAL ISSUE

Advocates of CTB have vigorously opposed the "stockpile reliability" issue as a major consequence of CTB which could reduce support for such an agreement in this country. In his monograph, *The Comprehensive Nuclear Test Ban*, Dr. Herbert F. York groups the issues pro, con, and "technical." He lists "stockpile reliability" as a "con" issue, which in itself suggests that test-ban advocates—while not openly pressing for a deteriorated stockpile—recognize that a test ban will adversely affect reliability. Regarding the present situation, York points out that:

Current nuclear weapons technologists regard stockpile reliability as an extremely serious question, emphasizing it above all others in their efforts to forestall a comprehensive test ban. . . .

Nearly all knowledgeable officials in the Department of Energy and the Department of Defense, and many in the international community support the position of the weapons laboratories.¹

Dr. York then discusses the notable letter to the President from Richard Garwin, Carson Mark, and Norris Bradbury claiming that stockpile reliability can be maintained in a test ban.² Pointing out that the Arms Control and Disarmament Agency, its consultants, and the President's advisors in the Office of Science and Technology Policy hold views similar to those of Garwin, Mark, and Bradbury, York continues:

The senior author of the present paper [York] like Bradbury a former nuclear weapons laboratory director, agrees with this latter minority opinion. . . . The laboratory staff can, on the basis of their experience, do a much more effective job of maintaining the stockpile in the absence of tests than the current staff and leadership are willing to admit on the record.³

To arrive at some judgment on this issue, it is necessary to delve into the Garwin/Mark/Bradbury letter to the President to determine what it really said, and what responses might be made to it. What is most surprising is that the United States should be involved in CTB negotiations with such a fundamental issue unresolved! Could we imagine, for example, such a debate on the Soviet side—wherein the chief of their delegation would be publishing a pamphlet questioning the judgment of the Soviet nuclear weapons establishment over a key issue in the negotiations?

The letter to the President was forwarded by Senator Edward M. Kennedy, a long-time nuclear test-ban advocate, right after Donald Kerr, Department of Energy, had testified before the House Armed Services Committee CTB Panel in August 1978 on the stockpile reliability issue.⁴ The Committee CTB panel held hearings in both March and August 1978, and issued a report, *Effects of A Comprehensive Test Ban Treaty on the United States National Security Interest*, in October 1978.

Dr. Kerr, speaking for the Department of Energy in August 1978 (he is presently Los Alamos Director) provided a much more detailed and comprehensive statement of the problem of nuclear stockpile confidence than is suggested in Dr. York's monograph. The Soviets interposed objections to Kerr's testimony (a TASS reporter having covered the House Armed Services Committee hearings) both in public and in Geneva.⁵ The Soviet complaint was that Kerr's testimony was inconsistent with the US negotiating position. Subsequent to the dispatch of the Garwin/Mark/Bradbury letter to the President, specific replies to the points raised in the letter were sought by the Committee CTB Panel from the laboratory directors, and taken into account in the final report of the committee.

KEY ARGUMENTS ABOUT STOCKPILE CONFIDENCE

What arguments did the Department of Energy and the weapons laboratories make, and what objections to those arguments were raised in the Garwin/Mark/Bradbury letter to the President?

Dr. Kerr's testimony on 14 August 1978, covered the key points of the DOE argument on nuclear stockpile confidence:

- The Department of Energy must assess the impact of any test ban on the capability to certify stockpile reliability. Certification is described as a "promise" to the Defense Department not only that weapons will perform within specifications and be safe in all operating conditions, but also that the weapons "can be relied upon to meet . . . requirements for a predictably long time."
- Stockpile aging, a growing concern, encompasses both technological obsolescence and physical deterioration prompted by the chemically active materials of which nuclear warheads are built. "We see evidence of corrosion and other deterioration which, if unchecked, would reduce the reliability of the weapons at some time in the future."
- "Nuclear tests are essential for determining the proper functioning of nuclear explosives," since calculations or experiments cannot simulate the performance of a nuclear weapon. This is why the Department of Energy maintains that, during a test ban, no new designs should be produced for stockpile. The nuclear laboratories have learned from the mistakes of the nuclear test moratorium era (1958-61).
- The argument is false that the rarity of "proof" detonations of weapons taken from stockpile means testing is not needed to maintain the stockpile. The continuing test program is used in confirming design choices made in stockpiled weapons, and in testing—as part of other experiments—fixes to stockpile problems. Tested technology is reused in working on stockpile problems. "In effect, 'proof' testing is built into the very philosophy on which our testing program is based."

Following Dr. Kerr's testimony of 14 August 1978, on 15 August 1978 the Garwin/Mark/Bradbury letter was dispatched to the President.

In introducing the subject of stockpile reliability in their letter, the authors assume that nuclear-yield testing on a laboratory scale (and implosion testing of fission and fusion designs without fissile material) will be continued under a CTB. Thus, they have in mind a threshold treaty, not a zero-yield CTB. While such assumptions are

often made in debating a CTB, it remains for assurances to be provided—probably in the form of Presidentially approved “safeguards”—that such necessary activities will actually be allowed to continue during the CTB regime. This issue is a question of interpretation, during a CTB, of what are to be the permissible activities, relative to nuclear testing, for stockpile or any other purposes.

In discussing what would happen during a CTB, the authors in their letter to the President attempt to refute the suggestion that government authorities might fail to fund stockpile maintenance activities and waive OSHA or EPA requirements levied on the weapons production complex. In addition:

We see no reason to assume that the national security bureaucracy will not continue to serve the national interest, and we would welcome a statement in conjunction with a CTBT that non-nuclear testing, inspection, and remanufacture where necessary will be fully supported in order to insure the continued operability of stockpiled nuclear weapons.⁶

This paragraph, near the end of the letter, in “welcoming a statement,” does not include in that request an assurance on continued laboratory-scale nuclear yield testing. It must be understood that ACDA and the technology policy office of the President could be expected to argue that anything not specifically promised by the President as a permissible activity during a CTB would be prohibited. Therefore, the caveat “with [nuclear-yield] testing limited to laboratory-type experiments,” upon which the position of the authors rests at least to a degree, is not part of the follow-through assurance they seek in order to keep even the “maintenance level” of test activity viable in our nuclear laboratories.

The key issue raised in the letter to the President then is:

Can the continued operability of our stockpile of nuclear weapons be assured without future nuclear testing? That is, without attempting or allowing improvement in performance. . . . Are there non-nuclear inspection and correction programs which will prevent the degradation of the reliability of stockpile weapons? Our answer is “yes.”⁷

The authors cite three “acceptable” approaches to the correction of deficiencies without nuclear testing (except for laboratory-scale experiments.) Note that their emphasis is only on maintenance—they

accept the proposition that the CTB should prohibit *any improvements*. In terms of nuclear disarmament theory, this is where the nuclear "arms race" ends—with a ban on improved nuclear weapons. Next begins the "roll-back" to eventually disarmed levels. See section 3.

The three "acceptable" approaches to stockpile maintenance in a CTB are:

- (1) Remanufacture to precisely the original specifications.
- (2) Remanufacture with minor modifications . . . after thorough review by experienced and knowledgeable individuals.
- (3) Replace the nuclear explosive by one previously tested and accepted for stockpile.⁸

A fourth "option"—using an untested design to replace failed stockpile weapons—is not recommended by the authors.

Noteworthy here is the assumption that "experienced and knowledgeable individuals" will be available to make judgments about remanufacture "with minor modifications." That would seem to be the only alternative the authors are offering. The complexity of a nuclear weapon has been compared to that of other high-technology articles such as a jet aircraft. Could we sensibly require Boeing to remanufacture B-52s to "precisely the original specifications"? The third alternative offered above appears to assume that there will be a previously tested and accepted article from the stockpile which will not be of questionable reliability and which provides the capability to replace the failed design. But is not this whole discussion about stockpile reliability? Can that problem be solved by assuming it does not exist elsewhere, if it does exist in one (or more) cases?

John C. Hopkins, Chief of Field Test and Verification for Los Alamos Scientific Laboratory, addressed the remanufacture/rebuild argument of test-ban advocates in the *Bulletin of the Atomic Scientists* in April 1977. His views do not appear to have been taken into account by the writers of the letter to the President. Hopkins lists three points relative to the "rebuild" claim: that problems arise frequently and "cannot be addressed practically or actually by rebuilding," that exact copies of 20-year old weapons are not feasible to produce, and that expertise is needed not only to *fix* deterioration, but also to *recognize* it.

The Energy Department made a formal reply to the House Armed Services Committee CTB Panel in response to the Garwin/Mark/Bradbury letter to the President, at the Panel's request. Key excerpts from Dr. Donald Kerr's statement on behalf of the Department of Energy reiterated the official position that "testing is required for long-term maintenance of the stockpile." Dr. Kerr observed that none of the letter-writers had personal involvement in the process of miniaturization of thermonuclear warhead designs which has made possible multiple independently targetable reentry vehicles (MIRVs). In view of past errors by designers in making seemingly "minor" changes, Kerr described as "incomprehensible" the attitude of Mark and Bradbury that design changes on stockpile weapons should not be "confirmed" with nuclear tests. The Department of Energy flatly disagrees with the Garwin/Mark/Bradbury assertion that the nonnuclear "sampling" program can be relied upon totally to detect faults, stating that, historically, the most serious problems have been detected as a result of the nuclear-yield test program. The Energy Department also does not accept the implication that no future improvements will be needed (or demanded) and that all future requirements can be met with tested designs.

Finally, the "maintenance" options suggested . . . are not viable alternatives without testing. Option (3) simply postpones the maintenance problem since all warheads age and will have to be replaced after a certain, known time. Both options (1) and (2) require "experienced and knowledgeable people" to guide and certify production. Without testing, such people will no longer be available after a few years. A long-term test ban will remove the crucial element of "certification" from nuclear production no matter how religiously the production plants attempt to copy old designs.⁹

The foregoing is an authoritative statement of the considered Energy Department position on the stockpile question. In view of this position, it is obvious that only a policy decision that the CTB should be of "fixed duration" can provide a rationale for continuance of those negotiations. But since a long-duration test ban is unendurable, why should this nation roll dice on a 3-year gamble that our stockpile will not drastically degrade?

TEST-BAN TREATY DURATION

The policy that the United States is negotiating a "fixed duration" CTB is designed to head off opposition based upon the stock-

pile confidence or "reliability" argument, because of lower probability of a stockpile problem occurring in a "fixed duration" period. Just as putting cruise missiles and mobile ICBMs in the SALT II Protocol and peaceful nuclear explosions into the CTB Protocol served the purpose of removing intractable issues for which no known solution was in sight—and which therefore would inevitably block adoption of the desired arms control agreement—making CTB a "fixed duration" agreement takes away the obligation of its proponents to show how the stockpile reliability problem can be solved in the long term.

Dr. Kerr also testified before the House Armed Services Committee on the question of a "fixed duration" comprehensive test ban. He stated that during a 3-year CTB the likelihood of some major problems with nuclear warheads in the stockpile is low, but not zero. While the expected lifetime of a weapon would be about 20 years, there have been more than a dozen instances in the past when stockpile problems arose that required nuclear tests for their resolution. The occurrence of such problems is not regular, but is unpredictable.¹⁰ In his testimony during the August 1978 hearings, Vice Admiral Robert R. Monroe, US Navy, Director of the Defense Nuclear Agency, also addressed the question of the predictability of stockpile problems:

Just as a fire department cannot predict where the next fire is going to be, they can predict with reasonable assurance that there is going to be a fire. Similarly in this business of stockpile reliability we have 30 years' experience showing the problems do occur, they are totally unpredictable, they can be very, very serious, and in many cases the only recourse is nuclear testing.¹¹

SAFEGUARDS

Another way that policy planning for a CTB has attempted to preempt the stockpile confidence issue is in provision for "safeguards" to go along with the CTB agreement itself. The Joint Chiefs of Staff were brought "on board" with the LTBT in 1963 by the President's guarantee of four safeguards to accompany the treaty.¹² Dr. Kerr was questioned on the safeguards issue during the August 1978 hearings—he replied the administration intended to submit a safeguards plan to the Senate at the same time a CTB would be forwarded for ratification. Such a plan would have various provisions, but in the view of the Department of Energy:

The overriding safeguard, the one that is best, would be the concrete expression of an intent to resume testing at the termination of the treaty.¹³

In a 12 September 1978 letter to the CTB Panel, Dr. Kerr provided Department of Energy answers for the record, elaborating upon questions asked during the August hearings. The expanded response of the Department of Energy on the question of "safeguards" during a CTB disclosed that it recommends a six-point plan, one of which calls for preparations for a "full-scale program for resumption of testing at the end of the treaty period." The Energy Department also places great emphasis on a national-level commitment to resume testing:

*The effectiveness of safeguards would depend on the level of nuclear experiments allowed by a CTB and on a number of other factors, not all of which are predictable. No safeguard can replace testing or completely prevent the eventual degrading effect of a long-duration nuclear test cessation on the US nuclear weapon capability. Therefore, the best safeguard is the assurance that testing will be resumed at the end of a CTB of limited duration, unless the safeguards plan and studies in the interim indicate that this is unnecessary.*¹⁴

The nature of nuclear weapons failure, or the mode of failure, is somewhat predictable, in contrast to the time of failure. Many experts believe that all or most weapons of a kind would fail together. That is, the uncertainty in weapons reliability which would be introduced by a test ban would also be an uncertainty about whether chunks of the "deterrent"—say, for example, all the Minuteman III W78 force—would be suddenly and drastically degraded.

It requires effort to adjust to even having to address the concept of "acceptable levels of unreliability," or risk-taking with nuclear weapons reliability. It is an alien approach. Consider for example, the discussion of "Degraded Reliability: Liability or Asset?" inserted into the House Armed Services Committee CTB Panel report by former Congressman Bob Carr. Congressman Carr's argument asserts the contradictory conclusion (with appropriate charts and graphs) that "if our reliability can . . . be kept higher than the Soviets, bilateral unreliability is to our advantage."¹⁵ What would be the likely reaction in Congress if a responsible military commander—for example, the Commander-in-Chief, Strategic Air Command—made such an assertion as a policy recommendation? Yet, in addressing

the debate over banning nuclear tests, one is forced—in the current milieu—to address the “issue” of the virtues of unreliable nuclear weapons! Perhaps a supernatural transformation is possible wherein all the excess reliability of nuclear weapons could be switched to nuclear power plants!

EXPERIENCES IN STOCKPILE CONFIDENCE TESTING

Donald R. Westervelt of Los Alamos continued the argument on the stockpile reliability issue in the February 1979 *Bulletin of the Atomic Scientists*. Responding to statements favoring CTB published in 1978 by William H. Kincade of the Arms Control Association, Westervelt emphasized the synergism among all nuclear tests. This synergism is achieved through testing of components common to different designs on devices not detonated primarily for purposes of reliability testing:

For Los Alamos weapons in stockpile there have been at least 89 instances where tests with other main objectives also confirmed the performance of those weapons or components. Thus, in the normal course of events a large data base has been accumulated about weapons in the stockpile. No data base like that which now exists would develop for scheduled new weapons, if all tests stopped for an indefinite period.¹⁶

Westervelt also refutes Kincade's assertion, the same one made by Garwin, Mark, Bradbury, York, and Panofsky, that “experience” shows the stockpile can be maintained without nuclear tests. Noting that these authorities are claiming not only that stockpile “proof” tests are not needed, but that no tests at all are needed, Westervelt observes that the only *relevant* “experience” of a total test cessation—the 1958–61 moratorium—showed just the opposite:

Only the 1961–62 resumption of testing allowed us to fix important problems found or suspected during the freeze. Also, and crucially important in looking ahead, is the fact that it was only the resumption of full-scale research and development testing that led to the discovery of by far the most significant stockpile problems. This discovery process will be needed, together with knowledgeable experienced people, so long as nuclear weapons exist.¹⁷

Donald Westervelt continues his rejoinder to the Arms Control Association President by addressing Kincade's point about the “impor-

tance of the reliability of the low-yield fission triggers of thermonuclear weapons." He recounts the sad experience of inadequate testing of the effects of decay of tritium used in boosting thermonuclear weapons, and concludes with lessons learned:

- The problem associated with tritium decay most probably would not have been found had the moratorium not ended;
- If it had been seriously suspected . . . abrogation of the moratorium to solve it would have been virtually imperative, although the needed tests were all small; and
- In their technical innocence, during a continued moratorium the laboratories would have found it easy to acquiesce in economically justified requests from the services to extend the stockpile lifetimes of the components in question.

This latter lesson is extremely important, as it highlights the danger of making nuclear weapons certification "a political act."

To put in perspective the scope of the problem identified in Donald Westervelt's point about lack of a data base on "scheduled new weapons," note that, according to DOE testimony in early 1979, the Phase III and post-Phase III programs for Los Alamos *alone* include the B-61 tactical bomb (in the versions which will incorporate the most advanced safety and security features), the W76/Mk 4 for Trident missiles, the W78/Mk 12A for Minuteman III and possibly for the MX as well, the W80/ALCM warhead, and the W81 for the Navy's SM-2 missile to go with AEGIS fleet air defense ships.

Thus, testimony and evidence presented by the Energy Department show that a CTB not only will undercut our means of maintaining confidence in an aging stockpile of existing weapons, but also will cause us to *build-in* reliability problems on a massive scale with all the warheads for programs now being touted as the modernized US strategic, tactical, and theater nuclear deterrent of the 1980s and beyond!

YIELDS FOR STOCKPILE CONFIDENCE TESTS

Michael M. May, an Associate Director of Lawrence Livermore Laboratory, provides a final key point of concern in the stockpile reliability controversy:

Low yield nuclear tests, which are difficult or impossible to monitor, are particularly important for this maintenance function, as they are for testing vulnerability. Without tests, we would be increasingly unsure of our stockpile.¹⁸

Thus it is that the testing we require to keep our stockpile confidence and maintenance procedures at high levels of proficiency will take place at "lower" levels of yield. According to separate questioning and testimony before Congress, the yield needed is in the area of up to ten kilotons:

MR. DOWNEY: What is inherent in testing a low yield device under 10 kilotons? What does that prove for you in terms of the reliability of your stockpile? What . . . would the Soviets gain if they tested a very, very low yield weapon?

Dr. KERR: I think the concept that we are attempting to put before you is that most of the questions related to stockpile reliability do not require the weapons to be tested at their full yield.

Both on our part and the Soviets' part, I would expect that the majority of stockpile problems would be addressed at yields substantially below the total yield. That is a different problem and a different set of questions than, for example, would you stockpile a megaton device based on a 10-kiloton test. . . . if you had a megaton weapon in stockpile and it developed the most probable problems you might be able to recertify the weapon with a 10-kiloton test.¹⁹

That is why the House Armed Services Committee Panel recommended that a yield threshold for testing be incorporated in any CTB, although having a threshold makes the title "CTB" a misnomer.

The lower the yield of a nuclear test, the harder it is to detect, that is, monitor for CTB compliance. In other words, a low-threshold treaty would be the most difficult—some would say impossible—to monitor. And we have separate testimony from the experts in monitoring that there will never be a comprehensive test ban, from the point of view of seismic monitoring capability. Yet, it is argued that these low yields are not militarily significant. Yet, the testimony is that lower yield tests will permit us to maintain our stockpile. Is that militarily significant?

NOTES

1. Herbert York and G. Allen Greb, *The Comprehensive Nuclear Test Ban*, California Seminar on Arms Control and Foreign Policy, Discussion Paper no. 84, June 1979, Santa Monica, California.

2. US, Congress, Senate, *Congressional Record* (CR), 17 August 1978, p. S13684, "In Support of a Comprehensive Test Ban." Insertion in CR sponsored by Senator Edward M. Kennedy includes text of 15 August 1978 letter to the President, with introduction by Kennedy. Nobel Laureate Hans Bethe "joined" with the authors of the letter, but apparently was not a signatory.

3. York and Greb, *The Comprehensive Nuclear Test Ban*, p. 33.

4. US, Congress, Senate, "In Support of a Comprehensive Test Ban."

5. See discussion of Soviet reaction in Geneva within overall discussion of events related to CTB in summer of 1978 in Nicholas Wade's "Defense Scientists Differ on Nuclear Stockpile Testing," in *Science* 201 (22 September 1978): 1105-1106.

6. Ibid. The "OSHA" problem is a major one for the nuclear weapons production complex. There is not time to go into it in any depth in this study, but the sanguine attitude of Garwin/Mark/Bradbury about the granting of "exceptions from OSHA or EPA requirements" is incredibly naive.

7. US, Congress, House, Armed Services Committee, HASC 95-89, pp. 181-82.

8. Ibid.

9. Ibid., pp. 175-76.

10. US, Congress, House, Armed Services Committee, HASC 95-89, pp. 10-11.

11. US, Congress, House, Armed Services Committee, HASC 95-89, p. 100.

12. US, Congress, Senate, Committee on Foreign Relations, *Nuclear Test Ban Treaty, Hearings on Executive M, 88th Cong., 1st sess., 1963*, "Letter

to Senator Russell from the Chairman of the Joint Chiefs of Staff re safeguards recommended by the JCS," p. 982.

13. US, Congress, House, Armed Services Committee, HASC 95-89, pp. 19-20.

14. Ibid., p. 45. (Emphasis added.) Disarmament dogma holds that the Soviets will respect a test ban and will not prepare to break out of it because our countries have "shared goals" such as to avoid a nuclear war. Theorists also assume that Soviet fear of a nuclear confrontation with the United States will compel the Soviets to sit still and let China's nuclear weapon developments run free of test restraints.

15. US, Congress, House, Armed Services Committee, HASC 95-90, pp. 38-44.

16. Donald R. Westervelt, "Can Cold Logic Replace Cold Feet?" *Bulletin of the Atomic Scientists*, February 1979, pp. 60-62. Mr. Westervelt is a Los Alamos staff specialist in arms control questions, having more than 20 years experience in nuclear testing. He is author of (with Robert W. Helm) "The New Test Ban Treaties: What Do They Mean? Where Do They Lead?" in *International Security*, Winter 1977; and "Candor, Compromise, and the CTB," *Strategic Review*, Fall 1977.

17. Ibid. Westervelt.

18. Michael M. May, "Nuclear Weapons: Where Do We Go From Here?" address at the Commonwealth Club of California, San Francisco, California, 10 March 1978, in *Vital Speeches of the Day*, 1978, p. 488. (Emphasis added.)

19. US, Congress, House, Armed Services Committee, HASC 95-89, p. 14.

VII. CTB AND NONPROLIFERATION

Contribution to "US nonproliferation objectives" is one of the most often claimed benefits for a CTB. Proliferation is regarded as a basic issue in CTB because of technical linkage, that is, testing of designs to certify workability and yield; and also because testing has become linked to proliferation in an attitudinal way through years of nuclear disarmament rhetoric dating back to the LTBT. The earliest efforts for a test ban were propelled, in part, by the idea that a nonnuclear weapon state, if pledged not to test, would not be in a position to acquire nuclear weapons, and therefore the test ban would halt the "horizontal" spread of nuclear weapons.

NUCLEAR PROLIFERATION ISSUES

Dr. Edward Teller effectively rebuts the argument that signature of a CTB Treaty by nonnuclear weapon states would be a reliable assurance that they would not acquire the weapons:

The Carter administration is attempting to prevent the spread of nuclear weapons . . . through a comprehensive ban on nuclear testing. Even if such a ban came into being, it would not prevent states from developing and stockpiling untested weapons. More dangerous than nuclear weapons is their secret existence in various countries. To the element of destruction would then be added the element of surprise.¹

The whole concept of "exemplary" behavior underlying the NPT and CTB thrusts toward arms control and nuclear disarmament has come in for a beating in recent years. Other nations—nuclear and nonnuclear—have been distinctly reluctant to take advantage of their opportunities to exercise "restraint" after the American model provided by our unilateral decisions in such cases as the B-1 cancellation, neutron warhead setbacks, a decade of delays in chemical retaliatory capability modernization, antisatellite test delays, cessation of ICBM production, Indian Ocean naval deployment limitations (through 1979), ceilings on conventional arms sales (through 1979), reductions in numbers of nuclear tests, extension of SALT I observance and voluntary observance of SALT II, and many other acts and policies of caution and restraint. The United States has negotiated

and has been observing the terms of the TTBT since 1976—but we apparently get no credit for that in the context of our nonproliferation policy.

The 19th Annual Report of the President on Arms Control described the outlook for the 1980 NPT Review Conference:

A number of countries have strongly linked SALT II and completion of a comprehensive nuclear test ban treaty with the NPT. These countries have indicated that US failure to ratify SALT II or to complete negotiations on the comprehensive test ban treaty will be viewed as a major failure by the nuclear weapon states to live up to their obligations under the NPT, in particular, the pledge in Article VI to negotiate limitations and reductions on their own nuclear stockpiles. It is more difficult for the United States to convince other states that their security is degraded by the acquisition of nuclear weapons if nuclear weapon states forgo limits on their own nuclear arsenals.²

If it is too much to demand that other nations cut back when the United States does, then on what basis do test-ban advocates continue to argue that additional US restraint will succeed, where previous examples have failed? Nevertheless, according to the periodical *Arms Control Today*, the US delegation at the 1980 NPT Review Conference made concessions on our country's CTB negotiating position in a failed attempt to reach agreement with hard-line Third World delegations.

In considering the issue of the linkage between a CTB and nuclear proliferation, it is most important to keep the role of testing in perspective within the total context of the proliferation problem. While many argue strongly that CTB is a sort of *quid pro quo* for nonproliferation decisions by nonnuclear weapon states, close analysis shows that many other major factors are at work. The perspective on this relationship is provided by Dr. Ernest W. Lefever in his Brookings Institution study *Nuclear Arms in the Third World*:

Nuclear proliferation is an untidy and imprecise term. The word *proliferation*, borrowed from biology, . . . often connotes an automatic, if not an inevitable process. Far from being automatic, the acquisition of nuclear weapons by any government is a profound and deliberate act of the will, a result of long and painstaking calculation of costs and benefits.³

Lefever's perspective is accurate, as reflected in the actual results of the 1980 NPT Review Conference. The customary "serious concerns" over lack of a CTB Treaty were expressed by prominent Third World and NPT hold-out states—such as India. And these concerns contributed to a failure to achieve consensus on a final conference document. However, petulance over lack of a great-power CTB Treaty did not lead to a "dismantling" of the nonproliferation treaty regime, or any defections among signatories. US Representative Ralph Earle stated:

There was virtually no criticism of the non-proliferation treaty itself or of its objectives. The parties continue their strong dedication to both and share a common desire to convince states that have not yet joined it to do so.⁴

In an address entitled "Nuclear Weapons—Where Do We Go From Here?" Dr. Michael M. May, Associate Director of the Lawrence Livermore Laboratory, dissects the nonproliferation argument for a CTB. Having pointed out that, in the absence of nuclear testing, the United States will face growing uncertainty about its nuclear stockpile, Dr. May continues:

The nations of most concern in connection with nuclear proliferation today either are now or are afraid to become isolated against formidable enemies. Whether they are right or not in their view of the world is not the point. The point is that they view the problem as one of security. They are far more likely to be influenced by steps aimed at improving this security than by US decisions on testing nuclear weapons which do not threaten them. It seems to me that the proliferation argument for a nuclear test ban rests more on what countries say they want at international disarmament conferences than on what they will actually do, and that we may pay a very high price to satisfy rhetorical goals.⁵

Two of the most prominent NPT hold-outs have been India and Pakistan. The concerns of the United States about trying to head off Pakistan's efforts to develop an "Islamic" bomb are well known and publicized. The key question is whether a cessation of all testing by the United States—in an agreement with the Soviets that would leave open their option to continue "peaceful" nuclear explosions (the same kind that India carried out in 1974), which could compromise our stockpile maintenance and confidence, and which would be of a "fixed duration" only—could provide a realistic incentive for Pakistan to join the NPT regime.

The nuclear proliferation issue has been an increasingly visible one in press reports and scholarly journals. These reports and articles make evident the diversity of issues in the nonproliferation question. If it appears at all, CTB is usually mentioned as a sort of afterthought, an obligatory reminder of historical policy stances taken in the context of nonproliferation arguments. While the assertion can be made that the absence of a CTB would be detrimental to the US nonproliferation policy, the converse does not appear to be true—that having a CTB will alleviate any of the many other practical problems we face, and can anticipate, in the proliferation realm in the foreseeable future.

Because nuclear nonproliferation influences so many areas of policy—because it cuts across so many kinds of issues—it is extremely difficult to generalize about what will happen with individual countries; and if, as in the cases of Pakistan and Iraq, they manifest a determination to continue their course to nuclear weapons development, it is a complicated matter to assess what steps by the United States would convince these “overhanging” proliferators to abandon their course. As George Quester puts it:

If the superpower arsenals were to grow by ten percent, nuclear proliferation would be more likely. But . . . if these arsenals were cut in half, the same might be true.⁶

CHANGING PERSPECTIVES ON PROLIFERATION

A significant source of information about change in the perspective on nonproliferation occurring in recent years is the major book *Swords from Plowshares—the Military Potential of Civilian Nuclear Energy*. As outlined by former Arms Control and Disarmament Agency Director Fred C. Ikle in his Foreword, studies sponsored by the US Government to achieve a “better understanding of the dynamics and dangers of the nuclear spread” resulted in major US nonproliferation policy changes during the mid-1970s. Ikle claims that “rarely has scholarly research been so immediately influential for changing government policy.”⁷ The basic change in awareness caused by the nuclear energy studies was that plutonium, naturally bred in uranium reactor fuel rods during the operation of nuclear power plants, is capable of being used in nuclear explosive devices, and that developments in the international nuclear power industry were trending in a direction toward creation of large amounts of uncontrolled weapon-

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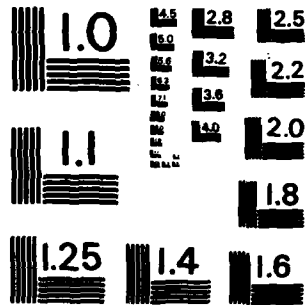
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useable plutonium obtained from reprocessing of the reactor fuel after its use. This has led to the US policy of imposing a ban on reprocessing, even though the commercial fuel cycle has been designed to be reliant upon reprocessing of spent reactor fuel.

Readers will search in vain in *Swords from Plowshares* for an exposition of the importance of CTB to nonproliferation. In the section "Life in a Nuclear Armed Crowd," devoted to an examination of the problem in the 1990s if many more countries acquire nuclear weapons, the writers point out that:

Despite the existence of much rhetoric justifying the acquisition, few of the countries with the capacity to make these weapons have done so. They have not acquired nuclear weapons because of high costs, internal political opposition, concern about reactions from neighbouring countries, and absence of perceived military threats and a belief in the adequacy of the guarantee provided by alliances.⁹

The authors coined the term "overhang" in referring to countries which could go nuclear in the next few years; but they cite unease about the decline of US power and influence as a major factor which would prompt nonnuclear weapon states to take out what the authors call "nuclear insurance." This, of course, is contrary to the notion that continued decline in US strength, particularly nuclear disarmament, will strengthen the nonproliferation regime.

How enticing would a CTB be to these "overhang" states? A test ban which would itself contribute to uncertainty about the US nuclear posture, and would not necessarily provide any other tangible benefits, would not be greatly impressive to the NPT hold-outs. A limited-duration CTB with the kinds of safeguards for us advocated by the Department of Energy (and presumably the Department of Defense)—"assured" resumption of testing under a "full-scale" program—could hardly be considered credible by the overhang proliferator states.

INERTIAL FUSION AND PROLIFERATION

As noted in section 5, some believe inertial confinement fusion (ICF) technology has a proliferation aspect.

Because understanding the ICF reaction process in a given target pellet could mean the same as understanding how a fusion ex-

plosive weapon would work, there are limits on disclosures associated with international exchanges of research results, or public disclosures of ICF-related technology. This is a separate issue from use of ICF research by the nuclear weapon states in order to continue advancement of the state of the art of nuclear explosives. The classification situation is described by Dr. David A. Dingee in his article "Fusion Power" in *Chemical & Engineering News*, 2 April 1979:

The bulk of the [ICF] research is done by the federal fusion-weapons research laboratories where thermonuclear devices have been perfected. . . . Since these national laboratory programs apply thermonuclear weapons know-how, in miniature, these programs are conducted under weapons security and administration.

In recognition of this, the Office of Laser Fusion has recently awarded to industry six research contracts totalling about \$5 million, on the basis of competitive bids. The companies involved . . . will gain access to classified data for their research.⁹

The FY 1981 ICF arms control impact statement gives a more detailed description of the proliferation potential thought to exist for ICF:

Concerns exist within the French, UK, US, and USSR governments that an ICF R&D program could be a precursor to an advanced nuclear weapons program insofar as non-nuclear weapon states used ICF work to acquire the information, technology, trained people and facilities applicable to nuclear weapon development.¹⁰

The impact statement also concludes that a near-fission weapon-capable proliferator state might be able to move more rapidly to a thermonuclear (that is, fusion) weapon capability if it were also conducting ICF research, and that thermonuclear weapon states "might derive some benefit for their weapon programs . . . from ICF research."

This hedged official assessment of the importance of ICF to the weapons programs of the thermonuclear weapon-capable states is different from the also-official assessments provided to the Congress by ICF experts of the Department of Energy. But even accepting the argument as advanced in the ICF arms control impact statement, it appears that exempting ICF from the comprehensive test ban will al-

low continuation of the "discrimination" against nonnuclear weapon states regarding nuclear test activities that the test ban is supposed to once-and-for-all eliminate.

While the ICF impact statement stresses that an ICF research program cannot replace a program of "full-scale and extensive" testing, which would be needed for a proliferator to perfect its nuclear weapons, the statement fails to mention the historic (and valid) US CTB negotiating position that *any nuclear explosion provides inherent military benefits*. If the thermonuclear weapon-capable states propose to continue with their ICF research, but strive to prevent potential proliferator states from using ICF research to cover up their proliferation activities, how can the nuclear weapon states argue that a CTB giving them an exemption for ICF will eliminate the "discrimination" regarding military benefits of nuclear testing? On the other hand, if the argument made in *Swords from Plowshares* that discrimination must *persist* is correct, the United States need not waste any more time trying to link CTB to nonproliferation.

THE TEST-BAN—PROLIFERATION LINKAGE

The linkage of CTB to nonproliferation has served the purpose—for CTB advocates—of making the test ban a sort of albatross on the entire nonproliferation effort. We hear time and again the rote claim that if the United States backs out of a CTB, or does not actively negotiate for one, the entire NPT "regime" is going to come apart.

It would appear that the time is overdue for US policymakers to view CTB in the context of its total linkage, and not harp to an extreme on the nonproliferation linkage. There could indeed be a nuclear armed crowd by the year 2000. But does it follow from that observation that the United States will not have a nuclear deterrent force and stockpile at that time? Some would suggest that the United States faces an either/or choice: either disarm or face the spectre of proliferation. The more likely eventuality is that we will have to cope as best we can with proliferation, while we maintain a nuclear deterrent posture.

The context of a CTB in relation to nonproliferation has changed very dramatically from the days of NPT ratification. Great expectations were in mind for the forthcoming SALT talks as a means of ful-

filling the Article VI obligation. On 11 July 1968, Paul H. Nitze, Deputy Secretary of Defense, and General Earl G. Wheeler, Chairman of the Joint Chiefs of Staff, testified before the Senate Foreign Relations Committee in favor of ratification of the newly negotiated NPT:

Senator SPARKMAN. The nonnuclear weapons signatories to this treaty expect that the major powers will make important progress in nuclear disarmament. What steps do you recommend that the United States take in order to fulfill this expectation? I will name three possibilities: A comprehensive test ban, a freeze on offensive and defensive strategic weapons, and a moratorium on ABM deployment.

Mr. NITZE. Mr. Chairman, it would seem to me that the most hopeful development now is the possibility for discussions with the Soviet Union on the offensive and defensive strategic missile systems. Now, exactly how those talks might go and what items might come up first and what the inter-relationship of them might be, I think it is too early to comment on.¹¹

Initiation of the SALT talks was delayed for over a year by an incident in Czechoslovakia occurring within 30 days of this testimony. The NPT was not ratified during the first session of the 91st Congress, and it became the responsibility of William P. Rogers to testify in favor of the NPT in his first appearance before the Foreign Relations Committee in public session as Secretary of State on 18 February 1969, just a few months after the Russian invasion of Czechoslovakia. Referring to the good work done by the negotiating teams during the Kennedy and Johnson administrations, Secretary Rogers reiterated President Nixon's statement to the press of 6 February 1969:

I did not gloss over the fact that we still very strongly disapproved of what the Soviet Union had done in Czechoslovakia and what it still is doing. But on balance, I considered that this was the time to move forward on the treaty, and have done so.¹²

Could it be that, in a relatively short time after the Russian invasion of Afghanistan, an American Secretary of State will be testifying on behalf of ratification of a comprehensive test ban as the necessary follow-on to the NPT? Is it possible he will be arguing that, although the United States strongly disapproved of what the Soviet Union had done in Afghanistan and what it still is doing, on balance

the United States should move forward with a CTB? Certainly this is a possibility, because the "process" of arms control and disarmament has been elevated to the very pinnacle of policy in our government.

On the other hand, our experience with "strategic" negotiations has grown greatly since 1969. When the United States examines its true security interest in the 1980s, and the outlook beyond the 1980s toward the twenty-first century, nuclear proliferation must take its place behind a number of critical challenges to our security policy and posture that will demand a greater priority.

NOTES

1. Edward Teller, "Technology: The Imbalance of Power," in *The United States in the 1980s*, eds. Peter Dunigan and Alvin Rabushka, Hoover Institution Pub. 228, Stanford, 1980, p. 523. See also Edward Teller, "President Carter's Nuclear Policy Is All Wrong," *Baltimore Sun*, 10 September 1978.
2. *19th Annual Arms Control Report*, "Non-Proliferation," p. 47.
3. Ernest W. Lefever, *Nuclear Arms in the Third World: US Policy Dilemma* (Washington, DC: Brookings Institution, 1979), p. 119.
4. "NPT Review Conference Held in Geneva," US Statement, 7 September 1980, in *Department of State Bulletin*, vol. 80, no. 2045, p. 35.
5. Michael M. May, "Nuclear Weapons: Where Do We Go From Here?" in *Vital Speeches of the Day*, 1978, p. 488. May, Associate Director of Lawrence Livermore Laboratory, delivered the speech at the Commonwealth Club of California, San Francisco, 10 March 1978.
6. George H. Quester, "Nuclear Proliferation: Linkages and Solutions," *International Organizations* 33 (Autumn 1979): 550.
7. *Swords from Plowshares: The Military Potential of Civilian Nuclear Energy*, Foreword by Fred Charles Ikle et al. (Chicago: University of Chicago Press, 1979).
8. "Life in a Nuclear-Armed Crowd," in *Swords from Plowshares*.
9. *Chemical and Engineering News*, 2 April 1979, p. 76.

10. US, Congress, *Arms Control Impact Statements, FY 1981*, Joint Committee Print.

11. US, Congress, Senate, Committee on Foreign Relations, *Nonproliferation Treaty Hearings*, 90th Cong., 2d sess., 1968, p. 59.

12. US, Congress, Senate, Committee on Foreign Relations, *Nonproliferation Treaty Hearings*, 91st Cong., 1st sess., 1969, pt. 2, p. 306. (Emphasis added.)

LIST OF ABBREVIATIONS

ABM	antiballistic missile
ACDA	Arms Control and Disarmament Agency
ACIS	arms control impact statement
AEDS	atomic energy detection system
BWC	Biological Weapons Convention
CCD	Conference of the Committee on Disarmament
CD	Committee on Disarmament
CTR	controlled thermonuclear reaction
DOE	Department of Energy
ENDC	Eighteen Nation Disarmament Conference
ENMOD	Environmental Modification Convention
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
HASC	House Armed Services Committee
IAEA	International Atomic Energy Agency
ICF	inertial confinement fusion
IHE	insensitive high explosives
INC	insertable nuclear component
ISDE	International Seismic Data Exchange
JCAE	Joint Committee on Atomic Energy
LTDP	Long-Term Defense Program (NATO)
MBFR	mutual and balanced force reductions
MCG	magneto-cumulative generator
MFE	magnetic fusion energy
MIRV	multiple independently targetable reentry vehicle
NNWS	nonnuclear weapon state
NSS	national seismic station
NWS	nuclear weapon state
OSHA	Occupational Safety and Health Administration
OSI	on-site inspection
PB	particle beam
R&D	research and development
RDT&E	research, development, test, and evaluation
RRR	reduced residual radiation
SAC	Strategic Air Command
SALT	Strategic Arms Limitation Talks
SCC	Standing Consultative Commission
SNM	special (fissionable) nuclear material
SSOD	Special Session on Disarmament (UN)

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If a researcher wishes to ignore the international aspects of nuclear testing, several series of documents contain information on nuclear testing policy as it is argued and formulated in our country. These include:

- Annual Defense Department Reports to Congress (DOD "Posture Statements")
- Annual Reports to Congress of the Under Secretary of Defense (Research and Engineering) ("DDR&E" Posture Statements)
- Annual Chairman of the Joint Chiefs of Staff (CJCS) report to Congress
- Arms Control and Disarmament Agency (ACDA) Annual Reports
- Documents on Disarmament Series (annual volumes)

- Department of Energy/Energy Research and Development Administration, Department of Defense, and Department of State testimony before the following congressional committees:

- Senate Armed Services Committee
- Senate Appropriations Committee
- Senate Energy and Natural Resources Committee
- Senate Foreign Relations Committee
- House Armed Services Committee
- House International Relations Committee
- Records of Joint Committee on Atomic Energy

Despite the plethora of material, coherent, organized histories of the nuclear testing policy issue covering the last 20 years are lacking. Three books listed here are outstanding histories of the period up to the 1963 Limited Test Ban Treaty. These are Earl Voss' *Nuclear Ambush*, Robert Divine's *Blowing on the Wind*, and Joseph Noguee's *Soviet Policy Toward International Control of Atomic Energy*. Divine's book is particularly noteworthy for an outstanding bibliographical essay. Voss' book contains a lengthy, detailed chronology of test-ban events from 1945 to 1963. It remains for researchers to update that chronology to the present. Such an update would be a valuable contribution.

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